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Some Problems of an Educated Minority: DR. OTIS W. CALDWELL 591

Obituary:

Elmer Peter Kohler: PROFESSORS ARTHUR B. LAMB, LIONEL S. MARKS and LAWRENCE J. HENDERSON.

Recent Deaths and Memorials 595

Scientific Events:

The Sixth International Congress for Experimental Cytology; British Honors; Stephen Timoshenko—Sixtieth Anniversary Volume; Doctorates of Science Conferred by Yale University 597

Scientific Notes and News 600

Discussion:

Plankton as a Food Source for Man: DR. GEORGE L. CLARKE. *Immunity to Fusarium Wilt in the Tomato:* G. W. BOHN and DR. C. M. TUCKER. *Maholi Galagos Breed in Captivity:* PROFESSOR FLORENCE DE L. LOWTHER. *Zoology for Pre-Medical Students:* HAROLD S. DIEHL. *Killing the Term Predatee:* PROFESSOR CARL L. HUBBS 602

Societies and Meetings:

The Illinois State Academy of Science: PROFESSOR R. F. PATON. *The New Hampshire Academy of Science:* DR. W. W. BALLARD. *The New York State Geological Association. Field Conference of Pennsylvania Geologists:* M. N. SHAFFNER 605

Special Articles:

The Relation of "Coenzyme R" to Biotin: DR. P. M. WEST and PROFESSOR P. W. WILSON. *Sand Culture of Cotton Plants:* DR. H. S. OLCOTT. *Physico-chemical Properties of the Rous Chicken Tumor Agent:* DR. KURT G. STERN and DR. F. DURAN-REYNALS. *On the Nature of the Agent Causing Leucosis in Fowls:* DR. KURT G. STERN and DR. ARTHUR KIRSCHBAUM 607

Scientific Apparatus and Laboratory Methods:

The Simplest Transparent Ultracentrifuge: PROFESSOR J. W. MCBAIN and A. H. LEWIS. *Funnel-heating Device:* L. N. MARKWOOD 611

Science News 6

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SOME PROBLEMS OF AN EDUCATED MINORITY[1]

By Dr. OTIS W. CALDWELL

GENERAL SECRETARY, AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

SCIENCE has been a constant factor in the education which has brought these young men and women to this, their graduation exercises. Science represents but one division of all the studies and experiences they have encountered. During most recent years their studies have been focused toward special careers, all scientific, broadly speaking. Previous to this specialization they and thousands of companions were engaged in what we call general education. To-morrow and afterward they look toward enployment in which they may use their general and their scientific education. Some have already found positions, others will find positions suitable to their training and ambitions. Some will not be so fortunate, if we may judge by the average results throughout American higher education. These average results are not primarily to be credited to or confused with current unemployment, but go to even deeper foundations in the American system of general and special education.

In this country we promise general education to all who wish it. Furthermore, we have laws which require that all young persons participate, so that those who do not wish education are more or less forcibly exposed to it anyway. Then, the educational system was asked to extend its years and to broaden its program so as to provide a living place for youth well toward their maturity. Some of these older youth are in educational institutions because they wish to be; some because they are nowhere else.

It is not news to any college administrator nor to the head of any professional college that the present educational situation causes many educationally drafted

[1] Address at the graduation exercises of the Medical College of Virginia, June 6, 1939.

but hardly scholarly students to seek places in technical lines—medicine, law, teaching, accounting, even the ministry. Indeed, our generous system of scholarship aid, originally designed to enable superior young people to gain the education they might otherwise miss, has sometimes been used to encourage mediocre minds to aspire to professions for which native capacity illy fits them. America's slogan of "Educational opportunity for each person" has been misunderstood by some to mean that any person, by means of enough education, may rise to the top in any profession. Doubtless, we shall continue to believe in educational opportunity for all. Literacy and a measure of participation in constantly growing knowledge are worthy purposes for every fairly normal human being. But creative scholarship is for those who have potentially creative minds. It is an unsolved problem of how a system of universal education can secure for all the general education needed, without raising false hopes for many who are not likely to succeed in the more specialized professional callings.

Some of the reasons for this dilemma are fairly clear. Hard physical labor by the many seemed unattractive when compared with what seemed to be the shorter hours, better and cleaner clothes and better pay of the professions. The shorter hours is a myth except for those who rise to less than the full measure of responsibility of the professions. There seems to be about as much card-playing, even bridge-playing, in one part of society as in another. Such things, in excess, are exponents of attitudes toward life rather than of mere quantity of education. If ease of living is one's major objective, higher professional education is hardly desirable.

Those now being graduated into higher scientific professions are welcomed into a fuller life, but not an easier life—a life in which well-intentioned mediocrity is not likely to be markedly successful. While the services of the sciences and arts are open to all who wish to know enough to enjoy them, the successful professional practice of the sciences and arts is open only to those of superior capacity, superior education and good social sensing of such callings.

The physician who cared for me during my childhood was a genius of his day. Let us not raise the question of whether he served society by helping me to live through the gamut of infectious diseases, then highly lethal, but now mostly under scientific control. That physician was almost self-educated. He read, rode and practiced under guidance of his predecessor of a still earlier generation. Whether his patients lived or died, he studied the results to guide him in subsequent cases. That doctor's fees were moderate though paid with difficulty and gratitude—sometimes paid mostly in gratitude. His house was the best in the whole community, his riding and driving horses the best, his advice and leadership gladly accepted by nearly all citizens. His occasional defeats by John Barleycorn were promptly forgiven by all except the preachers, who also forgave him when their next illness came upon them.

For this doctor's effective education, the community asked no return except the broad professional service which he gave. No one then thought of so-called socialized practice, which topic I shall not now discuss. But this truly educated man, hopelessly in the minority numerically, was almost a controlling factor in many aspects of community life.

In that early day there were but few successful physicians, and those, like other professional people, had little general education. The dentists always extracted offending teeth; any druggist was a pharmacist; the trained nurse had not appeared, and other professions were in similar stages of growth. Then, a system of public general education was developed, and slowly there came requirements of foundational education to precede specialization. To-day, we have the problem which arises from the tendency to rush through the years of general education toward the benefits of the special fields which can be reached only through higher and special education. We sometimes act as if we want to build the upper floors of our building without bothering much about the supporting foundations. Dean Le Baron R. Briggs, formerly of Harvard University, said:

> The university of today, carried away by its own development out of the college, has become dim-sighted toward two things: first, the relative importance of sound elementary training as compared with advanced scholarship, next the impossibility of advanced scholarship without such training. Few men can be original scholars; many may, by long and highly specialized work, become learned, and may find little to do with their learning when they get it. Tempting mediocrity to the higher learning has much to answer for. . . . No college ever made a man great; but many a college has helped a great man, and added efficiency to small ones.[2]

Minds of medium or average quality are far more common than are those either of *superior* or of *inferior* quality. But the ambition to participate in the superior intellectual callings is not limited to persons of superior minds. In a country in which education, even higher specialized education, is so nearly open to all, it is not surprising that so many teachers are illy prepared for teaching, that there are so many ordinary preachers, doctors, lawyers, dentists, nurses and pharmacists; that there occur so many well-meant but disappointing even tragic cases in practice by those who would have done better if they had been better.

"Oh," says our professional Pollyanna, "Look at

[2] L. R. Briggs, "Men, Women and Colleges," Houghton Mifflin and Company, 1925.

the magnificent improvements that have been made." Yes, they are very wonderful and one of the justly claimed glories of our day. In mechanical appliances we live farther from our great-grandparents than were they from the Pharaoh king, Tut-Ankh-Amen. But the material achievements, which almost surpass our appreciation, strongly illustrate the unbalanced development of specialized knowledge and practice. It probably requires the highest possible type of mind and of education to discover, invent or in some way to secure a development of masses of people who will make unselfish and constructive uses of our material achievements. Too many high-speed automobiles, bought upon hopeful-partial-payment plans, rush irresponsible groups to luridly advertised objectives, from whose exciting blandishments another homeward rush is made in order to be back on time at any regular post, if there be one, where productive employment is had. Surely it is a major problem, for the educated minority, to find good and attractive ways in which specialized knowledge may do the most good and least harm to society as a whole.

Times have changed greatly for most scientific professions, and other changes seem imminent. Since our whole educational system, including much higher professional education, has been opened to all and supported so largely by public expense and by endowment, as higher scientific training has become more costly, there has come increasing insistence that those with capacity to benefit from higher education owe part of their gains to the public. The problem is now presented as to whether education and the benefits therefrom belong wholly to any professional man.

An illustration of this is seen in the field of invention and patent rights. Highly trained and creative-minded men have discovered or devised mechanical improvements, new chemical combinations, new flower and food plants and plant products, and have secured patents covering their use. Patent rights have been issued upon many kinds of flowering and fruit plants and many thousands of mechanical devices and chemical and physical combinations. With new knowledge of chromosomes and genes, we may soon have patents not only on certain kinds of roses and hybrid corn as now exist, but might even have them upon milk cows and race horses. Accusations of infringement upon patents are constantly in the courts, based upon the legal right of those who secured the patents. Machines, medicines, books and all sorts of patented and copyrighted useful things are exponents of the growing stream of invention and creative work.

This problem directly concerns the discoverer or inventor, that is, a relatively small number of educated persons. It also concerns all people less directly, but no less certainly. And it is of tremendous import to present and future growth and use of knowledge.

We sometimes give too little attention to the fact that almost no great discovery, invention or combination of chemicals, of chromosomes or of physical forces is entirely new with the person or groups of persons who make the announcement. This fact does not lessen the importance of the announcement. Indeed, it increases its importance by showing that new things are usually merely additions to existing fundamental trends of thought and action. Adequate recognition of that which is new is desirable. But it is not desirable that a patent or copyright shall either allow the claimant to come into personal possession of the stream of thought of which his discovery is but one tributary or that his claim shall inhibit further discoveries of other tributaries which may later prove to be closer to the sources of the living springs of the whole stream.

Several persons and groups of persons in different nations had long been engaged in trying to make a vehicle which would operate without a horse to pull it. Success in this enterprise was almost simultaneously claimed by nearly a dozen independent workers. Similar principles and appliances appeared in all, as did dissimilar principles and appliances. Steam, gas and oil were each given a chance to supplant the inadequate horse. Although each worker doubtless wanted to know what others were doing, it seems likely that there was little actual stealing from one another. Rather, each worker had compassed the existing knowledge in the field and sought to add to it. The existing knowledge, in its previous development, showed the possible directions for the next steps, and independent workers sought to take those steps. That they took those steps almost simultaneously indicates some of the ways in which knowledge grows. To attempt to allow patent rights exclusively is to attempt to dam the huge stream of scientific thought. Such dams are soon undercut or washed aside, or the stream of advancing thought cuts around them.

The automobile also illustrates another phase of the problem. When it got started, vehicle-thinking was in terms of high wheels, narrow bodies, dashboards, buggy whips, high tops adjustable for rains and winds; and of roadways permitting a speed of four or five miles per hour. There was no need then of a club of drivers agreeing not to exceed 50 miles per hour. The first automobiles were little more than "horseless-carriages," named for the absence of the horse, resembling the old carriage which now operated while the unharnessed horse remained in the pasture. It required much constructive thinking, and will require much more, particularly in man's uses of it, to make a vehicle appropriate to the fundamental ideas of the automobile. Society is being taught to be uncomfortable when riding in an old model. Sales agents have learned the value of claims that new models include some of the sought-for added inventions. In fact, the

patents now being granted upon new automobile inventions do not stop, but merely delay the competitors.

The fundamental problem of "Whose are the inventions and the products of higher learning?" is not likely soon to be solved, but there are significant trends toward solution. Many years ago the University of Wisconsin rendered assistance to Professor Babcock in his research regarding milk production. The milk-tester which he invented sent the star-boarder cow to the butcher, gave a diploma of merit to the cow which more than paid her way, and gave a bank balance to the dairyman who decided to become scientific. But Babcock assigned the invention to his state university, and thus to the state which cooperated in his research.

Since the Babcock assignment the Wisconsin Alumni Research Foundation has been organized. To this foundation, university faculty members are invited to assign any patents they may acquire, the inventor receiving 15 per cent. of any financial returns therefrom. The rest of the proceeds from such patents are used by the university for further scientific research. During the past ten years over one million dollars of such funds have been used by the Wisconsin Alumni Research Foundation.

Certain other educational institutions now ask staff members to make assignments of patent rights, with varying recognition of the personal interests of the inventor. Such institutions are the California Institute of Technology, the University of California, University of Cincinnati, Columbia University, Harvard University, Iowa State College, Cornell University, Lehigh University, Massachusetts Institute of Technology, University of Michigan, University of Minnesota, Pennsylvania State College, Purdue University, St. Louis University, University of Toronto, University of Utah, and possibly others.

Then, there are separate research foundations to which patents are assigned, such as the Bartol Foundation of Philadelphia, Carnegie Institution of Washington, Chemical Foundation, National Research Council and Research Corporation of New York. These receive assigned patents, let them out to approved manufacturers, give an agreed percentage of the returns to inventors, and use the major part for further research. In the main these are non-profit organizations interested in the advancement of science.

Another type of control and use of new ideas is found in many industrial research organizations. Many years ago the Mellon Institute of Pittsburgh was established to discover, develop and use new ideas in industry. A cooperating industry makes a research allowance to the institute. The research worker is paid a salary. His results belong to the donor of his salary. The donor may give a bonus to his research worker if he chooses when the results of the research are financially valuable. All discoveries and resulting patents belong wholly to the donor of the research salary. Thus, the education, the labors and new ideas of the worker belong to the donor. Discoveries may be kept secret indefinitely if the industrial donor so desires.

At the other extreme is the policy of the Rockefeller Institute of Medical Research, which says all discoveries "are made freely available to the public. . . . Other than through the issuance of license, the Rockefeller Foundation does not participate in any way in the commercial preparation or sale of the manufactured chemicals; and it receives no royalties or other pecuniary benefits from the license it issues."[3]

A highly important corollary problem concerns new knowledge, discovery and invention in their relation to human employment. There is a wide-spread belief that new knowledge, as shown in new devices, destroys work opportunities. Scientific achievements are accused of removing workers from their jobs. The soap-box orator can point to the steam shovel in a building excavation and make his point by saying, "It is doing the work of twenty men." A mechanical wheat harvester was burned in my home county because laborers claimed it had lost them their wages. Yet even now, farmers can not secure adequate man power, at increased wages, to accomplish their tasks. What are the facts?

It is obvious that invention has reduced the quantity of demand for certain types of labor, and at the same time has changed the quality of labor needed.

In a recent address before the Florida Academy of Sciences, Dr. Allen presents figures which are illuminating. In the United States there are at least 18 major industries which were "entirely unknown 50 years ago."[4] During the past 50 years while our population has increased "118 per cent., the proportion of employed persons in the population increased 191 per cent." In Manhattan, New York, "there are now four times as many ways of earning a living as existed a quarter of a century ago." The manufacture and sale of transportation machinery now employs approximately ten times as many men as in 1900 were employed as "blacksmiths, stable operators, teamsters, harness workers and wagon and buggy builders." The electric refrigerator has stopped the daily trek of the ice man into the kitchen, and our 10,000,000 refrigerators demand more and better trained workers than previously handled ice. These operations now use tremendous quantities of products from farms, forests and mines, thus very greatly increasing the market for agriculture, forestry, mining and other productive enterprises.

[3] "The Rockefeller Foundation—A Review for 1938," Raymond B. Fosdick, 1939.

[4] Robert I. Allen, "Science versus Unemployment," SCIENCE, 1939.

This is not the proper occasion for further citation of such facts, but is the occasion for directing attention to the significance of such facts in relation to fundamental problems of our day. Persons who have had the benefits of higher education are needed as informed leaders. Instead of accepting and contributing to the disquiet of misunderstanding, instead of encouuraging the wishful thinking about the good old days, which can not come again, we need to redirect education in accord with the difficult but better present day and those which we should like to believe may be ahead of us.

The highly educated minority seems to be close to the crossroads in the progress of higher learning. Their leadership in thought and practice can continue only as they find effective ways to distribute useful knowledge and service and to lead the majority toward sympathetic participation in advancing knowledge. The mass of knowledge-consumers and users, even though they are not primarily discoverers, now need, and sometimes expect or demand, enough insight into new knowledge that they may appreciate its significance.

The older idea was based upon an authority possessed by the leader, who was an inventive scientist. But in our country, authority of persons as such will rapidly diminish. Known and demonstrable truth must be the final authority. They told Louis Pasteur in 1881 that he could not prevent anthrax in cows and sheep by his claimed vaccination. What authority did he use in proving his case? He said: "Provide cows and sheep for a public demonstration and we shall see the truth." On May 5, 1881, he vaccinated 6 of the 10 cows and 25 of the 58 sheep. Four cows, 23 sheep and 2 goats and 10 control sheep were not vaccinated. On May 17, 1881, the same sheep and cows were again vaccinated. On May 31, 1881, all cows and all sheep except the 10 control sheep were given fully virulent anthrax germs. On June 2, 1881, all unvaccinated cows, sheep and goats, except the 10 controls, were dead or severely ill. The truth was demonstrated and accepted.

Not only the material benefits from modern knowledge, but the science man's way of working need to be more fully understood and more widely used. Pasteur did little arguing. He presented truth and demonstrated the meaning of truth. He withheld nothing for himself. He sometimes expressed regret that so many uninformed people could not, or did not, wish to understand, but he found encouragement from those who did understand.

One of the biggest, probably the biggest, problem for an educated minority is that of extending the way of working, which is characteristic of discoverers, the real desire to know and use proved knowledge. Much bas been said about this, but not enough has been done.

Man's inquiring and daring mind is a scientific fact of the greatest significance. Man is an adventurous animal, always attempting something which no one has yet succeeded in doing. At his best, man always wants to do something for society which has not yet been accomplished. His worthy curiosity is a catalyst by which new knowledge and new services may come to society.

Whose is modern knowledge? Is it the property of such workers as the scientist? The administrator? The practitioner? The inventor? The manufacturing industrialist? Or is it held in trust by the better educated, but with the unavoidable obligation that all may be led into its benefits?

Surely, society has the right to expect the educated minority to be its sure-footed leaders, rather than that their superior education may be used by them merely to gain increased personal benefits through exploitation of their advantages.

The creative scientist, the scientific practitioner, the trained social worker, the educator, indeed all those who have benefited through higher education, have their largest, the most difficult and the best task still to be met.

OBITUARY

ELMER PETER KOHLER

THE following minutes were placed upon the records of the Faculty of Arts and Sciences of Harvard University at the meeting of February 14, 1939:

ELMER PETER KOHLER

Sheldon Emery Professor of Organic Chemistry

Elmer Peter Kohler was born on November 6, 1865, in the village of Egypt, Pennsylvania. His immigrant ancestor, Jacob Kohler, from Mühlhausen in Switzerland, in 1728–30, was the first settler in the vicinity of Egypt and acquired there a large tract of fertile land by warrants from the Penn Heirs. Through succeeding generations the Kohlers remained in Egypt as prosperous farmers, millers and merchants.

Elmer grew up on the ancestral farm and in the ancestral mill, profiting greatly from the education that they afforded. An alert, venturesome, self-reliant boy, unusually observant and thoughtful, he made botanical and mineralogical collections and learned the peculiarities of plants and the ways of animals. In the mill and among the farm machines which his progressive father installed he developed that mechanical skill which proved so useful to him in his later life. Above all, and by much hard work, he mastered the science and the practice of farming.

In 1886 he graduated, with honors, from the classical course at Muhlenberg College, in nearby Allentown. Shortly thereafter he journeyed West to seek his fortune and became a Special Passenger Agent on the Santa Fé. He was successful in this work and liked it, particularly the trips all over the Southwest, but he soon longed for wider intellectual horizons and in 1888 returned to Muhlenberg for another year of study.

At this time, through his own reading rather than by formal instruction, his interest in chemistry was awakened and in the following year he went to Johns Hopkins University to study organic chemistry under Ira Remsen. Johns Hopkins was then the Mecca in our country for those interested in the advanced study of this subject. Kohler developed rapidly in this environment and though previously untrained in chemistry obtained his doctorate in three years (1892).

Appointment to an instructorship at Bryn Mawr promptly followed and he was the first to teach organic chemistry at that institution. There he won recognition as a stimulating lecturer, an efficient teacher and a productive scholar. He soon became influential in the college at large and was recognized as the informal counsellor of the president, M. Carey Thomas, whose robust and discerning personality had so much in common with his own.

In 1912, after twenty fruitful and happy years at Bryn Mawr, Kohler came to Harvard to give the courses in elementary chemistry and in advanced organic chemistry, previously given by Charles Loring Jackson and Henry B. Hill, respectively. In 1914 he was appointed Abbott and James Lawrence Professor.

Kohler's academic career was interrupted in 1918 when he was granted leave of absence to assume the direction of research in the Offense Section of the Chemical Warfare Service of the United States Army. There, thanks to his broad knowledge of applied as well as theoretical chemistry, his good sense and his active and resolute leadership, he soon rescued this branch of the army's work from the confusion in which he had found it and made it a conspicuous success. He returned to Harvard in the fall of 1919.

Kohler's mature wisdom, keen insight and inveterate fairness were recognized at Harvard as they had been at Bryn Mawr and he was called upon to serve on many important committees. He was a member of the Administrative Board of the Graduate School for many years and in 1926 was Acting Dean of that School during the absence of Dean Chase. In 1934 he was appointed Sheldon Emery Professor of Organic Chemistry and in the same year he took over the chairmanship of the Department of Chemistry.

Kohler was in the full tide of his multifarious activities as investigator, teacher and administrator when he was overtaken by his brief, final illness. He died on May 25, 1938.

Kohler was preeminently an investigator, and as such was outstanding both in the extent and in the quality of his achievements. Arriving at Bryn Mawr young, inexperienced and isolated, he promptly began a long succession of significant, carefully planned, skilfully executed and elegantly reported experimental investigations in his chosen field of organic chemistry. In some of the experimental work he was assisted by able young women students whom he had himself trained, but most of his researches were carried out entirely with his own hands. At Harvard, in spite of his numerous duties as teacher, committeeman and administrator, his scientific productivity increased. He had, of course, many more collaborators and assistants than at Bryn Mawr, but he continued unremittingly his own personally executed investigations. Indeed, one searches in vain for any chemist in recent times who has turned out so great a quantity of experimental investigation performed with his own hands. He was a virtuoso in the experimental art. He had an encyclopedic knowledge of his whole field, keen insight and sound judgment.

Kohler possessed phenomenal powers of observation which functioned not only in his work but in all his daily contacts. A walk in the country or through city streets yielded him a surprising amount of information and his memory was unusually retentive. To the end of his life the physical minutiae of his observations as a lad on the farm or of his youthful experiences in the Southwest were as fresh as though they were of yesterday.

Most remarkable of all was the continued flexibility and freshness of his mind. He was always abreast of the times and to the last was as receptive and sympathetic to new ideas as the most enthusiastic youngster. His mental as well as his physical vigor was maintained undiminished up to his last brief illness.

Kohler was a great teacher. His skill as a lecturer and his wide, first-hand familiarity with the everyday applications of chemistry to agriculture, to industry and to physiology brought him success in Chemistry A, the introductory course in general chemistry. His astonishing grasp of the bewilderingly multiplex and protean science of organic chemistry and his flair for simple and lucid presentation established his Chemistry 5 as a veritable masterpiece famous among organic chemists the country over.

More important, however, than his activities as a lecturer were his daily associations with his students in the laboratory. It was here that he left an indelible imprint. A thorough training in organic chemistry was the immediate goal of his teaching, but diligence, forethought, independence, enterprise and integrity were his more fundamental objectives. Practicing what he preached, a zealot in his science and a master of his craft, he taught as much by example as by precept. Truly Spartan in his own life, Kohler scorned sentimentality and always told the simple truth as he saw it, no matter how unpalatable it might be. Firm, courageous and indomitable, he was a wise and kindly counsellor and a loyal friend.

ARTHUR B. LAMB, *Chairman*
LIONEL S. MARKS,
LAWRENCE J. HENDERSON,
Committee

RECENT DEATHS AND MEMORIALS

DR. ARTHUR EDWIN KENNELLY, professor emeritus of electrical engineering at Harvard University and at the Massachusetts Institute of Technology, died on June 18 at the age of seventy-seven years.

DR. GEORGE ELWOOD NICHOLS, professor of botany and director of the Botanical Gardens at Yale University, died on June 20 at the age of fifty-seven years.

EDWARD K. PUTNAM, director of the Davenport Public Museum, Iowa, died on May 22 at the age of seventy years. Mr. Putnam entered the service of the museum, at that time called the Davenport Academy of Sciences, in 1906 as acting director and served continuously until his death, becoming director in 1927. He has been the principal benefactor of the museum and was managing director of the William Clement Putnam estate trust, which was set up for its support.

CHARLES NEWELL COBB, supervisor of science instruction for the New York State Education Department for thirty-four years until he retired in 1927, died on May 6. He was eighty-four years old.

THE death is announced of Dr. Karl von Auwers, professor of chemistry at Marburg, and of Dr. Hans Böker, professor of anatomy at Cologne.

IN announcing the death of Professor Edwin Linton in the issue of SCIENCE for June 9, the date was incorrectly given. He died on June 4.

IN the vestibule of the new Dunning Science Building, which is in course of erection at Washington College, Chestertown, Md., there will be placed carved marble plaques of Ira Remsen, from 1876 to 1913 professor of chemistry of the Johns Hopkins University and president of the university from 1901 to 1913, and of John Jacob Abel, from 1893 to 1938 professor of pharmacology at the Johns Hopkins University. The plaques represent each in relief, with tributes to their work carved in the marble.

IT is reported in *Nature* that the centenary of the birth of Théodore Ribot and the jubilee of the foundation of the chair of experimental psychology in the Collège de France, of the Laboratory of Physiological Psychology at the Sorbonne and of the thesis, "L'Automatisme psychologique," submitted by Pierre Janet, would be celebrated by a gathering at the Sorbonne on June 22, under the presidency of the Minister of National Education. Among those taking part were Professor P. Janet and Professor H. Piéron, who succeeded Binet as director of the laboratory at the Sorbonne. A jubilee volume, in which many psychologists are collaborating, is to be published in honor of Ribot, Binet and Janet, who were the pioneers of scientific psychology in France.

SCIENTIFIC EVENTS

THE SIXTH INTERNATIONAL CONGRESS FOR EXPERIMENTAL CYTOLOGY

THE sixth International Congress for Experimental Cytology will be held at Stockholm from July 25 to August 1, 1940. The following preliminary program has been arranged by the Swedish organization committee, the president of which is Professor John Runnström, and the secretary Dr. Sven Hörstadius, whose address is Wenner-Grens Institut, Norrtullsgatan 16, Stockholm. For each topic, review papers given by invited speakers will be read at the general sessions. Discussion of the papers will follow. Four afternoons will be devoted to demonstrations and to the remaining papers submitted. The preliminary program follows:

July 25: Opening of the congress. Rhoda Erdmann Memorial Lecture.

July 26: Proteins: their structure and rôle in biological processes. The physical analysis of protoplasmic structure: x-rays; double refraction. The electron microscope. Viruses.

July 27: Surface films and their properties. The problem of permeability. Electro-physiology of the cell. Demonstrations.

July 29: Cell metabolism. Demonstrations. Miscellaneous short papers.

July 30: Morphology of the cytoplasm. Protoplasmic changes during physiological activity. Demonstrations. Miscellaneous short papers.

July 31: The nucleus and cell division. Sexual substances (fertilization substances) of the gametes, their chemical nature and their genetical control. Demonstrations. Miscellaneous short papers.

August 1: Cell physiology and development. Normal and abnormal growth. Tissue culture.

The program outlined has been developed from the point of view of cellular physiology. It is pointed out that the conventional distinctions between physical chemistry, biochemistry and cellular physiology have at present no sharp borders, and that place has been reserved for physico-chemical discussions of the behavior of the components of protoplasm.

The Swedish committee hopes that there will be at this congress ample opportunity for fruitful contact between experimental cytologists and workers in related fields. Opportunities will, however, be provided for the arrangement of informal afternoon sessions wherein smaller groups may enjoy unrestricted discussion. The membership fee has been fixed at twenty-five Swedish crowns.

BRITISH HONORS

FROM the list of honors arranged on the King's birthday *Nature* selects the following men of science and others associated with scientific work:

Baronet: Dr. R. Hutchison, president of the Royal College of Physicians; *K.B.E.:* Professor W. B. Benham, emeritus professor of biology, University of Otago, Dominion of New Zealand; Professor T. A. Hunter, professor of philosophy and psychology, Victoria College, University of New Zealand; the Honorable P. H. Rogers, judge of the Supreme Court and chancellor of the University of Sydney. *Knights Bachelor:* Dr. E. J. Butler, secretary to the Committee of the Privy Council for Agricultural Research and secretary to the Agricultural Research Council; F. Carnegie, chief superintendent of Ordnance Factories, War Office; Dr. R. E. Kelly, professor of surgery, University of Liverpool; Professor J. Graham Kerr, M.P. for the Scottish Universities since June, 1935, formerly regius professor of zoology in the University of Glasgow; Professor O. W. Richardson, Yarrow research professor of the Royal Society, University of London; Professor J. F. Thorpe, chairman of the Smoke Sub-committee, Chemical Defense Committee, War Office, emeritus professor of organic chemistry in the University of London and in the Imperial College. *C.I.E.:* C. E. C. Cox, chief conservator of forests, Central Provinces and Berar; H. R. Stewart, director of agriculture, Punjab; E. A. Smythies, chief conservator of forests, United Provinces; W. J. Jenkins, officiating director of agriculture, Bombay. *C.B.E.:* A. S. Cox, assistant comptroller, Patent Office, Board of Trade; Seton Gordon, for services to literature and natural history; C. E. Legat, for services to the Empire Forestry Association; G. M. Mathews, a prominent ornithologist, for services to the Commonwealth of Australia; J. P. Mead, director of forestry, Straits Settlement, and adviser on forestry, Malay States; Professor E. J. Salisbury, Quain professor of botany, University of London; R. J. L. V. Sukuna, district commissioner and chief assistant, Native Lands Commission, Fiji. *O.B.E.:* E. J. Bruer, livestock expert to the Government of Bombay; Dr. G. P. Douglas, assistant superintendent (research), Royal Aircraft Establishment, Farnborough; Dr. W. E. Fisher, principal, Wolverhampton Technical College; Professor W. G. R. Paterson, principal and professor of agriculture, West of Scotland Agricultural College, Glasgow; H. F. Mooney, forest officer, Eastern States Agency, India; J. Sinclair, for services to agriculture in the Nyasaland Protectorate; A. A. Topp, manager of the Government Explosives Factory, Maribyrnong, Commonwealth of Australia; J. Turner, forestry officer, Department of Natural Resources, Newfoundland. *M.B.E.:* B. M. Cameron, manager, Government Stock Farm and Agricultural Station, Acre, Palestine; A. P. Dodd, chief entomologist to the Prickly Pear Board, Commonwealth of Australia; W. M. Findlay, superintendent of experiments and lecturer in seed testing, North of Scotland College of Agriculture; Miss E. A. Leighton, accountant, Building Research Station, Department of Scientific and Industrial Research; A. F. MacCulloch, advisory chemist, Medical Store Depot, Madras; T. K. Mirchandani, officiating deputy conservator of forests, Bombay; Miss U. F. M. Morton, principal, Women's Medical School, Agra, United Provinces; K. R. N. Pillai, extra assistant conservator of forests, Jubbulpore, Central Provinces and Berar; H. G. Smith, statistician, Agricultural Department, Uganda Protectorate. *I.S.O.:* J. M. Dunbar, assistant and office superintendent, Department of Agriculture, Gold Coast.

STEPHEN TIMOSHENKO—SIXTIETH ANNIVERSARY VOLUME

THE arrival of Timoshenko in 1922 has proved to be a significant event in the development of engineering in the United States. There was, at that time, a lack of engineers competent to deal with the vibration problems which were arising as a result of the increasing use of high-speed machinery, the stability and buckling problems which resulted from the endeavor to make structures lighter by the use of thin walls and other similar problems in the general field of applied mechanics. To meet this need adequately it was necessary to have, in one person, a great scientist and a great teacher. Timoshenko has filled this need in full measure.

Associating himself with the Westinghouse Electric and Manufacturing Company in 1923, he found at East Pittsburgh an unusually able group of graduates of engineering schools. The majority of these had been subjected to a four-year course in engineering of the then familiar pattern and had acquired only the most elementary knowledge of mathematics and applied mechanics. Timoshenko, a born teacher, gathered these fledglings under his wing, without any official prompting or assistance, and proceeded to educate them. He became a peripatetic university for the group. Sunday mornings saw a practical exemplification of the legendary activity of Mark Hopkins in the woods and fields around East Pittsburgh. The intellectual horizon of the disciples was rapidly extended because of the close integration of their discussions with their work problems. In the interval from 1923 to 1927 there was enacted one of the most striking educational developments of our times. The men who were in that group are now among our most prominent professors of applied mechanics and our most able engineers.

The influence of Timoshenko was by no means limited to his immediate disciples. His long array of books and papers dealing with many of the new problems in civil and mechanical engineering had already made him known as a pioneer and his stream of publications has continued uninterruptedly. In a short time he was universally accepted as the leader in those fields with which he dealt. His appointment to a professorship in applied mechanics in the University of Michigan in 1927 established a new center of influence and attracted not only graduate students but also teachers and practicing engineers. His genial person-

ality tied his students and associates to him with a bond of deep affection.

It is small wonder that the occurrence of Timoshenko's sixtieth birthday was seized upon as an opportunity for a demonstration of gratitude, respect and affection, not only by those who had studied under him or had otherwise been associated with him, but also by other engineers of distinction who worked in the field of applied mechanics. The leaders in this field in other countries—in England, Germany, Holland and Turkey—were not to be denied the opportunity of joining in this demonstration.

The "Sixtieth Anniversary Volume of Contributions to the Mechanics of Solids" which was presented to Timoshenko at his birthday dinner contains contributions from thirty scientists. The contributors include Prandtl, G. I. Taylor, von Karman, Southwell, Biezeno, Westergaard, Nadai, Den Hartog, von Mises and other recognized leaders. Their papers cover such problems as buckling, vibration, friction, fatigue, elasticity, dynamic stability, stress analysis, creep and plasticity. The book is a serious contribution to the solution of many problems in the mechanics of solids.

LIONEL S. MARKS

HARVARD UNIVERSITY

DOCTORATES OF SCIENCE CONFERRED BY YALE UNIVERSITY

YALE UNIVERSITY on June 21 conferred the degree of doctor of science on Dr. Hans Zinsser and on Dr. Ross Granville Harrison. The remarks made by Professor William Lyon Phelps, public orator of the university, in presenting the candidates, and the citations of President Charles Seymour, in conferring the degrees, follow:

HANS ZINSSER, SC.D.

Professor Phelps:

After graduating from the School of Medicine at Columbia in 1903, Dr. Zinsser began his lifelong uncompromising war against infectious diseases. Within seven years he had attracted the attention of experts; and was called across the United States to be professor of bacteriology at Stanford University. Three years later Columbia recaptured him and in 1923 he made the Northeast Passage, unfortunately not stopping at New Haven, and became professor of bacteriology and immunology in the Medical School at Harvard.

But the Western Hemisphere was not large enough either to provide sufficient material for research or to contain his rapidly growing reputation. Like Scipio, he carried the war into Africa and later into the Far East. His textbook has been translated into Chinese.

During the World War, he was a member of the Red Cross Sanitary Commission to Serbia and with the rank of colonel he had charge of laboratories to protect the health of American soldiers. He received the Distinguished Service Medal, and his manual for the sanitation of a field army is a model.

Meanwhile his researches continued with unabated energy. Two of his works have served as excellent guidebooks for medical students, physicians and public health officers.

He made an aggressive attack on the dreaded typhus fever, a scourge always accompanying war and famine. He isolated and manipulated the germ of typhus called Rickettsia, and from it succeeded in preparing a protective vaccine. By careful experiments often at personal risk, he has done more than any other investigator to clarify the various forms of these protean diseases, recognizing them in their deceptive disguises. A few years ago Dr. Zinsser gave some of the results of his studies in popular language through his exciting book "Rats, Lice, and History." With impressive logic relieved by original humor he showed the effects of man's poor relations among animals and insects; and this book has not only influenced investigators; it has been profitably consulted by historians.

He is one of the foremost laboratory scientists; and in the midst of his war against disease he has made friends everywhere in the world; his chronic courage is salted with humor; for although he is a medical philosopher, we may say of him what Edwards said to Johnson, "cheerfulness is always breaking in."

President Seymour:

Brilliant in the most daring and dangerous investigation, unmatched in color and clarity of exposition, master of detailed analysis and utilizing a wealth of humanism to enrich and illumine your scientific synthesis, Yale confers upon you the degree of Doctor of Science and admits you to all its rights and privileges.

ROSS GRANVILLE HARRISON, SC.D.

Professor Phelps:

In 1907 a very good thing happened to Yale. Dr. Harrison came hither as Bronson Professor of Comparative Anatomy. The chair was well named, for he had been teaching first at Bryn Mawr, and then at Johns Hopkins. Equipped with a Johns Hopkins Ph.D., and also a charming wife and an M.D. degree acquired at Bonn on the Rhine, the Sheffield mansion became his workshop and the house afterward called Mory's his home. In a few years he created the first university department at Yale, with the perilous honor of serving on both the Sheff and academic faculties as well as those of the Graduate School and the School of Medicine. He planned the Osborn Memorial Laboratories.

His classic papers on the development of the lateral line and the muscle nerve relationships in the frog focussed the attention of American scientists. When the arguments concerning the origin of peripheral nerves had reached a stalemate Harrison answered the question by growing the nerve tissues outside the body. This brain child, known as Tissue Culture, has grown to gigantic size. It is a method universally applied to living systems and to the solution of fundamental problems in both biology and medicine.

As an investigator he is known for his complete, critical and thorough attack upon the very heart of a problem. The experiments are perfectly planned and executed. In his teaching he has been the advocate of the "Sink or

Swim'' method as a result of which his scientific progeny in this country occupy many of the key posts. Strength has produced strength.

His honesty and integrity as man and scientist have received universal commendation. His scientific career has justly secured recognition throughout the world. He bears his honors with simplicity. In all ways he is genuinely and affectionately known wherever biologists are gathered as *''The Chief.''*

In all his honors he has shown the modesty, simplicity and kindness to those less gifted, which are characteristic sometimes of great minds. Retired from the field of active teaching, he gives his full time to research. He carries with him the affection and the respect of all members of the Yale Brotherhood.

President Seymour:

Revered and beloved leader, eminent scholar, selfless and inspiring personality, for the services you have rendered to this university in its laboratories, its schools of the arts, science, medicine—undergraduate and graduate—for your investigations and discoveries, and for the example you have given to American universities as the perfect scientist, Yale honors herself in conferring upon you the degree of Doctor of Science, admitting you to all its rights and privileges.

SCIENTIFIC NOTES AND NEWS

THE doctorate of science of Harvard University was conferred on June 22 on Dr. Percy W. Bridgman, on Dr. Charles F. Kettering and on Dr. Hans Zinsser. President Conant made citations as follows: Percy W. Bridgman, Hollis professor of mathematics and natural philosophy, Harvard University—"An experimentalist who transforms stubborn matter by high pressures; a logician who alters physical theory by acute analysis." Charles F. Kettering, engineer, president of General Motors Research Corporation, Dayton, Ohio—"An engineer in the great American tradition, an inventor whose imagination has quickened both industry and science." Hans Zinsser, Charles Wilder professor of bacteriology and immunology, Harvard University—"A dynamic teacher whose vision extends beyond his laboratory; a famed investigator of the secret ways of man's microscopic enemies."

COLGATE UNIVERSITY, at its one hundred and eighteenth commencement on June 12, conferred the doctorate of laws on Dr. Charles August Kraus, professor of chemistry at Brown University, president of the American Chemical Society.

THE University of Pennsylvania, on June 20, conferred an honorary doctorate on Dr. Joel H. Hildebrand, professor of chemistry at the University of California.

BROWN UNIVERSITY conferred on June 19 the doctorate of laws on Dr. Vannevar Bush, president of the Carnegie Institution of Washington, previously dean of engineering and vice-president of the Massachusetts Institute of Technology.

AMONG the honorary degrees conferred at the one hundred and seventieth annual commencement exercises at Dartmouth College on June 18 was the doctorate of science on Charles Franklin Kettering, president of the General Motors Research Corporation.

THE University of Rochester conferred honorary degrees on June 19 on Dr. Peter Henry Buck, director of the Bishop Museum, Honolulu, and on Dr. Philip A. Shaffer, dean of the Medical School of Washington University, St. Louis.

THE honorary degree of doctor of public health has been conferred by New York University on Dr. Sigismund S. Goldwater, commissioner of hospitals of New York City.

THERE was held at the University of Sofia, Bulgaria, from May 20 to 26 a celebration of the fiftieth anniversary of its foundation. On this occasion there were named ninety-two doctors *honoris causa* for outstanding achievement in various scientific and other directions. Of these the following were from America: Professor G. D. Birkhoff, Professor Claude Burton Hutchison, Professor Vladimir N. Ipatieff, Professor Albert Russell Mann, Professor William F. Russell, Professor Joseph Alois Schumpeter and Nikola Tesla.

THE Theobald Smith medal and prize of $1,000 has been awarded by the American Association for the Advancement of Science to Dr. Albert B. Sabin, of New York City, associate of the Rockefeller Institute for Medical Research, in recognition of his work on pneumococcus infections.

THE Society for the Promotion of Engineering Education on June 21 awarded the Lamme Medal for achievement in engineering education to Dr. Stephen Timoshenko, professor of mechanical engineering at Stanford University.

THE Lord Mayor of London, on behalf of British foundrymen, on June 14 presented a gold medal to Dr. T. A. Schwartz, research manager for the National Malleable Steel Casting Company, of Cleveland, for his research contributions to the progress of the foundry industry. Dr. Schwartz at the time was in London to attend a meeting of the International Foundry Congress.

THE Albert Medal of the Royal Society of Arts for 1939 has been awarded to Sir Thomas H. Holland, principal and vice-chancellor of the University of

Edinburgh, in recognition of "his services to the mineral industries." The Albert Medal was established in 1862 as a memorial of the Prince Consort, who was for eighteen years president of the society. It is awarded annually for "distinguished merit in promoting arts, manufactures or commerce."

THE trustees of the Academy of Natural Sciences of Philadelphia have elected as corresponding members: Professor W. C. Allee, University of Chicago; Dr. Glover M. Allen, Museum of Comparative Zoology, Cambridge; Professor F. Baltzer, Zoological Institute, Bern; Dr. R. S. Bassler, United States National Museum; Dr. Albert F. Blakeslee, Carnegie Institution of Experimental Evolution; Dr. Willis S. Blatchley, Indianapolis; Professor Maurice Caullery, Paris; Dr. Lucien Chopard, Museum d'Histoire Naturelle, Paris; Dr. Hubert Lyman Clark, Museum of Comparative Zoology, Cambridge; Dr. J. A. Cushman, Sharon, Mass.; Professor Theodosius Dobzhansky, California Institute of Technology; Dr. F. E. Fritsch, East London College; Professor Jesse M. Greenman, Missouri Botanical Garden; Professor G. D. Harris, Ithaca, N. Y.; Dr. Wilhelm Michaelsen, Hamburg Museum; Dr. James P. Chapin, American Museum of Natural History; Professor A. S. Pearse, Duke University; Dr. Andeas Petrovitch Seminov, Leningrad; Dr. A. H. Westergaard, Geological Survey of Sweden.

HAROLD J. COOLIDGE, JR., has been elected an honorary member of the Cercle Zoologique Congolais, in recognition of his work on the fauna of the Congo.

DR. PATRICK MARSHALL, professor of geology at Otago University, New Zealand, has been made president-elect of the Australian and New Zealand Association for the Advancement of Science for the Adelaide meeting to be held in August, 1940.

AT the St. Louis meeting of the American Society for the Study of Allergy, officers for the coming year were elected as follows: *President,* Warren T. Vaughan, Richmond, Va.; *President-elect,* Robert L. Benson, Portland, Ore.; *Vice-president,* Milton B. Cohen, Cleveland, Ohio; *Secretary-Treasurer,* J. H. Black, Dallas, Texas.

THE following nominations for officers of the American Society of Mechanical Engineers for 1940 have been announced: *President,* Warren H. McBryde, consulting engineer, San Francisco; *Vice-presidents,* Kenneth H. Condit, consulting editor of *American Machinist,* McGraw-Hill Publishing Company; Francis Hodgkinson, honorary professor of mechanical engineering, Columbia University; J. C. Hunsaker, head of the department of mechanical engineering, the Massachusetts Institute of Technology; K. M. Irwin, Philadelphia Electric Company.

RETIREMENTS at the close of the academic year of members of the faculty of Northwestern University include: Dr. Herbert A. Potts, professor of oral surgery; Dr. William C. Bauer, professor of electrical engineering; William H. Burger, professor of civil engineering; Dr. William H. Haas, professor of geology and geography; and William G. Smith, professor of engineering drawing.

REAR ADMIRAL WAT TYLER CLUVERIUS, U. S. Navy, retired, has been elected president of the Worcester Polytechnic Institute. He will succeed Rear Admiral Ralph Earle, retired, who died in February after serving for fourteen years as president of the institute.

DR. WILLIAM H. MARTIN, professor of plant pathology at Rutgers University, has been appointed dean of the College of Agriculture at the university and director of the New Jersey Agricultural Experiment Station, to succeed Dr. Jacob G. Lipman. Dr. Martin has been serving as acting dean and acting director since the death of Dr. Lipman in April.

DR. EDWARD J. MOORE, professor of physics at the University of Buffalo, has been appointed dean of the Graduate School of Arts and Science.

DR. G. KINGSLEY NOBLE, curator of herpetology of the American Museum of Natural History, has been appointed visiting professor of biology in the Graduate School of New York University.

DRS. ROBERT D. BOCHE, of the Carnegie Laboratory of Embryology, and Irwin C. Kitchin, of the Rice Institute, have been appointed assistant professors in the department of zoology of the University of North Carolina.

DR. GEORGE R. COWGILL, professor of physiological chemistry at Yale University, has been elected editor of *The Journal of Nutrition* in place of Dr. John R. Murlin, who recently resigned. Also elected to the editorial board are Dr. Icie Macy Hoobler, Dr. Henry A. Mattill and Dr. Harold H. Mitchell. The editorial office of the journal after July 1 will be at New Haven, Conn.

PROFESSOR ROSS G. HARRISON, of Yale University, chairman of the National Research Council, delivered the Linacre lecture at St. John's College, Cambridge, on May 16. He spoke on the "Development of the Internal Ear—a Study in Experimental Embryology."

THE following series of lectures will be given at the Biological Laboratory, Cold Spring Harbor, Long Island, by Dr. Fritz Eirich, of the department of colloid science of the University of Cambridge: July 19, "Oxidation in Monolayers"; July 21, "Serum Reactions with Colloidal Tungstic Oxide"; and July 24, 26 and 28, "High Molecular Compounds." These lectures will begin at 2 P.M.

THE exchange of visits between the Kaiser Wilhelm

Gesellschaft of Berlin and the Royal Society, London, was continued on June 22 with a lecture by Professor F. Wever, of Düsseldorf, entitled "A Review of the Development and Present State of Metallurgical Research"; and on June 23 with a lecture by Professor Otto Hahn, of Berlin-Dahlem, who spoke on "The Fission of Uranium Nuclei by Neutrons."

THE Puerto Rico chapter of the honor society of agriculture, Gamma Sigma Delta, held its initiation banquet on May 20. The guest speaker was Dr. Harry H. Love, professor of plant genetics of Cornell University. Rafael Menéndez Ramos, dean of the College of Agriculture and Mechanic Arts, introduced the speaker. The eight initiates included five graduating seniors of the College of Agriculture, two members of the Puerto Rico Experiment Station, and one from the Insular Department of Agriculture. Following the initiation election of officers was held and the following were elected for the coming year: *President,* Professor Rafael A. Toro; *Vice-President,* Dr. Arthur G. Kevorkian; *Secretary,* Professor José A. Ramos; *Treasurer,* Professor Jorge H. Rodríguez; *Historian,* Professor Rivera Valiente.

THE Louisiana State University has completed the equipment of its new astronomical observatory by the installation of a Clark refractor of eleven and a half inches aperture. The principal address at the dedication ceremonies was given by Professor W. L. Kennon, of the University of Mississippi, who spoke on "Astronomy in America." The director of the observatory is Dr. David Vance Guthrie, professor of physics and astronomy at the Louisiana State University.

THERE has been organized at Youngstown, Ohio, the Mahoning Valley Academy of Science with about sixty members, most of whom are engaged as instructors in the Youngstown College or as teachers in the local high schools.

ACCORDING to the *Journal* of the American Medical Association, a new National Institute of Hygiene and Public Health in Lima, Peru, has been opened officially by the president of the republic. The institute, created by a government decree on July 23, 1937, is under the supervision of the ministry of public health, labor and social welfare. Dr. Telemaco Battistini is the director. It has three departments: bacteriology and immunology, entomology and experimental medicine. The department of bacteriology and immunology, which are directed by Dr. Battistini, will engage in the manufacture of serums, vaccines and glandular extracts, which will be sold to government controlled hospitals, municipalities and certain other public agencies at cost. The department of entomology, under the direction of Dr. Marshall Hertig, formerly of the Harvard Medical School, will for the present work exclusively on Carrion's disease, or "verrugas," which is endemic in certain areas of Peru, notably in Verrugas, about 99 kilometers from Lima. Later it is expected that research will be instituted on malaria, which causes the greatest morbidity of any disease in Peru. The department of experimental medicine, which is directed by Dr. Alberto Hurtado, professor of medicine in San Marcos University, will cooperate with the department of entomology in its study of Carrion's disease.

DISCUSSION

PLANKTON AS A FOOD SOURCE FOR MAN

ACCORDING to a recent news report the German State Biological Institute at Helgoland is investigating the possibility of harvesting the plankton of the sea as a new food source for the German market to make Germany still more independent of foreign imports. Zooplankton was reported to have a nutritive value equivalent to the best meat and phytoplankton to be equal to rye flour. Since the nature and abundance of the marine plankton has been the subject of several recent investigations at the Woods Hole Oceanographic Institution, it is of interest to examine the feasibility of the German proposal from the quantitative point of view.

There is no question that plankton is rich in food materials. A typical zooplankton catch, consisting chiefly of copepods, yielded the following analysis when dried:[1] fat 7 per cent., protein 59 per cent., carbohydrate 20 per cent. and chitin and ash 14 per cent. In fact, the fat content of crustacean plankton sometimes exceeds 30 per cent. Certain whales, sharks and many kinds of fish feed on plankton almost exclusively.[2] Plankton has been claimed to be palatable by biologists who have eaten catches of it on occasion, and shipwrecked crews "are said" to have subsisted on plankton strained through handkerchiefs.

There is plenty of plankton in the ocean, but the essential problem in the practical application of the scheme is the difficulty of separating such small organisms from the water in sufficiently large quantities. Considering first the phytoplankton (including nannoplankton), we know that for the ocean as a whole it must bulk larger than the zooplankton since the latter subsists upon it, but the extremely small size of the individual cells presents a very serious obstacle to mass collection. The most efficient method which has

[1] J. Johnstone, "Conditions of Life in the Sea." Cambridge, 1908.

[2] G. L. Clarke, Fifth Pacific Science Congress, Vancouver, B. C. A5. 5 p. 2017, 1934.

been developed has proven successful for obtaining diatoms in quantities large enough for chemical analysis (*i.e.*, by the kilogram),[3] but since the maximum rate at which the diatom sludge could be accumulated during periods of abundant flowering was a liter in about six hours and since the work involved the services of three men and a forty-foot power boat, the method obviously would not be practical for obtaining a food supply for man.

Zooplankton can be procured much more readily because its larger size makes possible the use of coarser nets which, due to their stronger mesh, can have larger filtering surfaces and can be towed at faster speeds. The abundance of zooplankton is extremely variable both in time and in place. But even in the relatively rich Atlantic coastal area between Cape Cod and Chesapeake Bay catches greater than 2 liters in volume (per 20 minute haul at 1.2 knots with net 1 m in diameter) were rarely encountered in a four-year survey reported by Bigelow and Sears.[4] These authors concluded that the average concentration of zooplankton in this area during the season of maximum production was about 0.5–0.8 cc per cubic meter of sea water. Plankton was much scarcer during the winter. Comparison with other investigations showed that the plankton of European waters was little, if any, richer. Since plankton is at least 90 per cent. water, we may take as an outside figure a value of 0.1 g dry weight of plankton per m^3 of sea water. Even though the plankton may actually be richer, this figure gives the order of magnitude of the amount *which can be caught* using the most efficient methods yet devised.

Since the foregoing data are available one is tempted to make a rough calculation of the amount of ocean which would be required to sustain a man. Assuming an energy yield of 9 cal/g for fat, and 4 cal/g for protein and carbohydrate, we find that the combustion of 1 gram of dried plankton would yield about 4 cal. If a value of 3,000 cal per individual be taken as the average daily requirement of the population,[5] about 750 g of plankton would be needed per man per day, *assuming all the organic matter in the plankton to be assimilable.* On the basis of 0.1 g plankton/m^3 each member of the population would require all the zooplankton from *at least* 7,500 m^3 each day (approximately equal to the volume of a football field filled 1.5 m deep). Using the largest net generally found practical (2 m in diameter)[6] at a fast towing speed (2 knots) and assuming a 20 per cent. straining efficiency for a coarse net,[7] a period of 2½ hours would be necessary to filter this volume of water. If several nets were used simultaneously, more men and larger boats entailing greater operating costs would be required.[8] Even though plankton be considered only as a subsidiary food source, it must be obtained economically in order to form an efficient part of the whole dietary scheme. We are forced to conclude, therefore, that if the marketing of plankton on a commercial scale is to become a practical reality, either areas of greatly increased richness must be located or some method must be found for making the above rate of procuring plankton economically feasible.

GEORGE L. CLARKE
HARVARD UNIVERSITY AND
WOODS HOLE OCEANOGRAPHIC INSTITUTION

[3] G. L. Clarke, SCIENCE, 86: 593, 1937.

[4] Memoirs of the Museum of Comparative Zoology, 1939 (in press).

[5] G. Lusk, "The Elements of the Science of Nutrition." Philadelphia, 1928.

[6] A net 4½ m in diameter but with relatively coarse mesh was used by the *Discovery* (J. W. S. Marr, *Discovery Reports*, 18: 105, 1938).

[7] Reported by G. L. Clarke and D. J. Zinn (*Biol. Bull.*, 73: 464, 1937) and confirmed by tests with the plankton sampler—a recently developed device equipped with volume meter.

[8] There might be some possibility of operating economically a filtering plant in the tidal flow between suitably located islands or in the entrance of an estuary.

IMMUNITY TO FUSARIUM WILT IN THE TOMATO

GREENHOUSE and field tests of the resistance of several wilt-resistant tomato varieties to *Fusarium lycopersici* Sacc. (F. *bulbigenum* var. *lycopersici* Woll.) showed that infection was almost universal when environmental conditions were very favorable for the development of the disease. The resistant varieties survived for longer periods than susceptible varieties, but usually died before the growing season ended.

In a search for more effective resistance to *Fusarium lycopersici* in a plant cross-fertile with the tomato, numerous accessions of Lycopersicum and related genera were exposed to infection by virulent isolates of the parasite. All accessions of species in genera other than Lycopersicum proved immune. A few attempts to produce intergeneric hybrids were not successful. Accessions of *L. esculentum* Mill. exhibited various degrees of resistance and development of external symptoms, but all were susceptible to infection. Accessions of *L. pimpinellifolium* Mill. from several sources varied greatly in reaction to *F. lycopersici;* one proved very susceptible; several were somewhat resistant; one, Accession 160, remained free from infection and apparently possessed immunity.

The immune accession of *L. pimpinellifolium* was received from Dr. W. S. Porte, U. S. Department of Agriculture, Washington, D. C., who wrote of it, ". . . our No. 2116 was obtained by F. P. I. from Dr. Wolcott, who picked it up near Trujillo, Peru."

In contrast to the resistance or tolerance of commercial varieties of tomatoes to *Fusarium lycopersici,* immunity in Accession 160 was effective under con-

ditions very favorable to the development of the disease. In greenhouse and field experiments of 1935 to 1938, in which nearly all plants of commercial resistant varieties were infected, Accession 160 and its F_1 hybrids with susceptible varieties of *Lycopersicum esculentum* remained free from vascular discoloration. Injection of a suspension of a virulent isolate of the fungus into the stems failed to produce the disease in Accession 160 or in the F_1 hybrids, although plants of the Bonny Best variety used as controls were killed by the fungus within 28 days. Accession 160 was not infected on autoclaved soil infested with 39 isolates of *Fusarium lycopersici* from various regions of North America and other continents; several of these isolates killed all plants of Bonny Best and Marglobe checks within 45 days.

Tests of several thousand plants in various progenies from crosses between Accession 160 and several susceptible commercial varieties proved that immunity to *Fusarium lycopersici* in tomatoes is dependent on a single, dominant genetic factor. The factor for immunity was maintained in the heterozygous condition in a series of 4 back-crosses to susceptible varieties. Its potency was not decreased in the fourth back-crosses or their progenies.

Large fruit size and various other characters of commercial value were obtained in some plants of advanced generations and many of the plants could not be distinguished from large-fruited forms of *Lycopersicum esculentum*. Although they were heterozygous for a large number of factors affecting fruit and plant characters, preliminary tests indicated that some plants in progenies from self-pollinated flowers of selections derived through outcrossing immune selections to commercial varieties for four generations were homozygous for immunity.

Various lines are being tested and subjected to selection to obtain plants homozygous for the factor for immunity, and for factors for desirable fruit and plant characters. The linkage relations of the gene for immunity are being studied. The data will be reported in detail, elsewhere, at an early date.

G. W. BOHN
C. M. TUCKER

UNIVERSITY OF MISSOURI

MAHOLI GALAGOS BREED IN CAPTIVITY

IN September, 1937, I received two Maholi galagos from South Africa. This is a well-known, dwarf variety of lemuroid with a body about six inches long and hind legs which are slightly longer than the body. Like all lemuroids, they are nocturnal, and this variety normally hops about in the tops of trees. In July, 1938, the female matured, but fertilization did not take place. On December 15, 1938, there was a second period of heat, and four months later, April 14, 1939, two galagos were born. So far as I have been able to determine, this is the first time that the Maholi galago has bred young in this country. There are many cases recorded of young having been born among the lemurs while in captivity in the various zoos abroad, and in some instances the period of gestation has been recorded. I am unable, however, to find any record of the period of gestation for the Maholi galago.

Just before the birth of the twins the expectant mother tore up quantities of paper in an effort to make a nest in a small box inside her cage. At birth the young were well covered with grayish fur and the eyes were partially open. They could cling to the perpendicular sides of the cardboard box in which they were born by means of their adhesive pads on both hands and feet. The mother, if disturbed, would clutch one of her offspring in her mouth, usually by the middle of its back or even by its ventral surface. She is able to jump as much as ten feet with her offspring dangling from her mouth.

FLORENCE DEL. LOWTHER

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COLUMBIA UNIVERSITY

ZOOLOGY FOR PRE-MEDICAL STUDENTS

A QUESTION which is raised by practically every student preparing for the study of medicine is, "How much science work, and particularly how many and what courses in zoology, should I take?" The answer, which I believe most deans of medical schools ordinarily give, is, "Take only those courses which are required for entrance to medical school."

In many liberal arts colleges, however, students who are preparing for the study of medicine are advised to take as much work in zoology as they can possibly get in. The usual assumption which is the basis of such advice is that the additional science work will better prepare the student to carry the medical curriculum. This seems logical, but, we ask, "Do these extra science courses sufficiently enhance the average student's ability to profit by the medical course to justify his taking them to the exclusion of other studies which in all probability he will never again have an opportunity to pursue?"

To throw some light upon this particular question we have compared the medical school grades in certain courses earned by students who had had similar courses in departments of zoology with the grades of other students in the same classes who had had no such courses. Specifically, the comparisons were as follows: The grades in gross human anatomy of one hundred students who had had comparative anatomy were compared with the grades of one hundred students who had not had this course; likewise the grades of one hundred students in human embryology, one

hundred in human histology and fifty in human physiology who had had corresponding courses in "arts colleges" were compared to the grades of the same numbers of students who had had no such courses.

There were no significant differences between the abilities, as judged by average college grades and by average scores on Medical Aptitude tests, of the groups of students who had had and those who had not had the various zoology courses.

Analysis of these data shows that the students who had had comparative anatomy did approximately 10 per cent. better in gross human anatomy than the students who had not had such a course. The calculation of statistical probabilities indicates that there are 36 possibilities in 100 that this average difference in grades is due to the operation of chance in sampling. Whether one considers this probability as statistically significant is a matter for individual judgment, but, except for other possible values which the students might get from comparative anatomy, it is questionable whether the time and the effort expended are justified by the 10 per cent. better average work which the students who have taken comparative anatomy do in gross human anatomy.

In human embryology and in human histology there are no significant differences between the grades of the students who had had and those who had not had similar courses in the "arts college." Those students who had had a physiology course in a zoology department did not do as well in human physiology as those who had had no such course. This difference is sufficiently great to be considered statistically significant; although it is probably without much importance.

While this study may not answer the question as to how much work in zoology a prospective medical student might profitably take, it does present evidence that the argument that a student should take a multiplicity of zoology courses because they will specifically help him in his medical school work is fallacious. There may be a slight justification on this basis for recommending comparative anatomy, but there is none whatsoever for embryology, histology or physiology.

HAROLD S. DIEHL

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KILLING THE TERM, PREDATEE

IN reply to Professor L. D. Wooster's "Proposing the Term, Predatee" (SCIENCE, 89: 436, 1939), may I point out that the word *prey* denotes "any animal that is or may be seized by another to be devoured" (second definition in Webster's New International Dictionary, second edition). Therefore, *predatee* is unnecessary and, we hope, abortive. This protest is not offered in the spirit of conservatism, for I have persisted, with others, in using such naturally formed and needed words as predator, predation and speciation, until they have become recognized by the lexicographers, and am continuing to take part in the process of word-speciation by using, for example, a new verb, *to speciate*.

CARL L. HUBBS

UNIVERSITY OF MICHIGAN

SOCIETIES AND MEETINGS

THE ILLINOIS STATE ACADEMY OF SCIENCE

THE thirty-second annual meeting of the Illinois State Academy of Science met in Springfield on May 5 and 6. The meeting opened with a general session held in the Centennial Building of the State Capitol group. The governor of Illinois, though unable to attend, sent a letter of welcome, and the superintendent of schools, R. E. Fildes, gave a short address of welcome. Dr. George D. Fuller, of the University of Chicago, the retiring president, presented an interesting paper on the interglacial and postglacial vegetation in Illinois. Dr. Charles A. Shull, of the University of Chicago, also gave a paper at the general session on plant growth and growth hormones. This session closed after short talks by Anton Tomasek, state forester, on state forests in Illinois and by Dr. Thorne Deuel, chief of the State Museum, on some interesting exhibits prepared by the museum staff especially for those attending the annual meeting.

The section meetings in the afternoon were unusually well attended, some 140 papers being presented in the nine sections offering programs. Several sections were obliged to divide their programs. One section in geology was virtually a symposium on geological features of Illinois. Chemistry, botany and zoology also were able to arrange separate programs around topics of specialized interest. The physics section met separately in the morning discussing with the representatives of medical schools in the state the problem of physics in premedical education.

Immediately after the section meetings a general business meeting and election was held. The officers of the academy for 1939–1940 are: *President,* Evelyn I. Fernald, botany, Rockford College; *First Vice-President,* Theodore H. Frison, Natural History Survey, Urbana; *Secretary,* Robert F. Paton, physics, University of Illinois; *Treasurer,* John Voss, Manual Training High School, Peoria.

Two resolutions of general interest were also passed unanimously:

Resolved, that the Illinois State Academy of Science hereby reaffirms its general approval of the efforts of the

Associated Conservation Organizations of Illinois to further the Commission plan for the administration of the Department of Conservation in Illinois as embodied in the resolution of the 31st Annual Meeting of the Academy published in the *Transactions* of June, 1938.

Resolved, that the Illinois State Academy of Science express its approval of any action of the State Legislature or of other agencies public or private looking toward the preservation of sites within the state which are of archeological, historical, and of scientific interest.

The Junior Academy had its usual enthusiastic meeting. Some fine exhibits were set up in the local high school gymnasium and the groups representing the many high-school science clubs in the state showed high enthusiasm. Dr. C. T. Knipp, of the University of Illinois, gave the evening address to the Junior Academy, giving some interesting demonstrations of his singing tubes and other experiments he has developed. Dr. H. K. Gloyd, director of the Chicago Academy of Sciences, gave the annual public lecture of the Senior Academy, talking on the animal life in the Arizona deserts.

The annual tradition of scientific pilgrimages on Saturday was maintained by four such excursions into the surroundings of Springfield, which are especially rich in scientific and historical material.

At the council meeting on Saturday it was voted that the next annual meeting be held in Galesburg, Illinois, on May 3 and 4, 1940.

R. F. PATON

UNIVERSITY OF ILLINOIS

THE NEW HAMPSHIRE ACADEMY OF SCIENCE

THE twenty-first annual meeting of the New Hampshire Academy of Science was held on June 2 and 3 at Dartmouth College, Hanover, N. H. At the Friday evening session, Professor W. B. Unger showed motion pictures of Australian mammals and birds, and Mr. A. E. Bent, secretary of the Mount Washington Observatory, showed colored films of the mountains, the work at the observatory and hurricane damage at high altitudes. There followed a social meeting at the Wilson Museum sponsored by the Dartmouth Scientific Association. Professor C. J. Lyon and others made an exhibit for this meeting of specimens of most of the local wild flowers of the season, and the Dartmouth Natural History Club exhibited a collection of over fifty kinds of living animals from the vicinity. Other demonstrations of the local bird studies and of new state and academy publications were on view.

At the Saturday morning session, the chief feature was a symposium, "The Hurricane of September, 1938, and its After-Effects." The meteorology of the hurricane was discussed by Professor C. F. Brooks, of the Blue Hill Observatory. Forestry aspects were treated by W. F. Hale, assistant state forester, and L. W. Rathbun, of the Society for the Protection of New Hampshire Forests. Mr. Kenneth Roberts spoke on flood control aspects, and T. J. Dent, of the New Hampshire Fish and Game Commission, and John Pearse, of the U. S. Biological Survey, discussed the effects of the hurricane on animals and game management.

On Saturday morning, the Dartmouth Eye Institute presented a program of four papers introducing their accomplishments and research projects. The Eye Institute was opened for the inspection of the academy members.

Saturday afternoon was given over to the reading of papers by other members, to the business meeting and to the address of the retiring president, Dr. Henry I. Baldwin, on "Scientific Freedom."

At the business meeting it was voted to award the grant-in-aid for the current year from the American Association for the Advancement of Science to Professor W. W. Bowen, curator of the Wilson Museum, Dartmouth College, for assistance in completing "A Survey of Bird Population Density in Relation to Various Ecological Factors." The publication committee announced plans for publishing a bulletin on "Glacial Geology of Mt. Washington" by R. P. Goldthwait and for replacing the mimeographed account of the annual meeting by a formal printed "Proceedings" containing abstracts of papers presented.

The following officers were elected for 1939-40: *President,* Professor George W. White, University of New Hampshire; *Vice-President,* Professor Bancroft H. Brown, Dartmouth College; *Secretary-Treasurer,* Professor W. W. Ballard, Dartmouth College; *Members of Executive Council,* Dr. Henry I. Baldwin, State Forestry Department, for five years, and Mr. Henry S. Shaw, Exeter, N. H., for three years.

W. W. BALLARD,
Secretary

THE NEW YORK STATE GEOLOGICAL ASSOCIATION

MORE than 160 persons attended the meeting of the New York State Geological Association on May 12 and 13 at Canton, N. Y., where the St. Lawrence University acted as host. The Gouverneur marble quarries, the Richville feldspar mine, where 42 different minerals have been found, the Edwards zinc mine, the Fowler talc mine, "Lost River," an underground portion of Boland Creek, the Reservoir Hill phacolith near Gouverneur, eskers, kames, pro-glacial deltas and lake features were visited in the field.

On Friday evening the annual dinner was held in the Men's Residence of St. Lawrence University, after which the following program was given: Address of Welcome, President Laurens H. Seelye; "Minerals of

St. Lawrence County," Dr. D. H. Newland, New York State Museum; "Some Aspects of Pleistocene Geology," Professor Earl T. Apfel, Syracuse University; "Adirondack Rocks in Kodachrome," and Movies of Buffalo Meeting, Professor H. L. Alling, University of Rochester; Report of Nominating Committee, Professor G. B. Cressey, Syracuse University.

The visiting delegates left for their homes on Saturday afternoon enthusiastic about the talks which they had heard and the geological features which they had seen and with their cars laden with mineral specimens collected.

The officers for next year are Professor George H. Chadwick, *president;* Robert W. Jones, *secretary-treasurer,* who will succeed Dr. Robert Wesley Brown and Dr. John S. Brown, retiring president and secretary-treasurer, respectively. The association is eagerly looking forward to next year's meeting, which will be held in the Catskills.

FIELD CONFERENCE OF PENNSYLVANIA GEOLOGISTS

THE ninth annual meeting of the Field Conference of Pennsylvania Geologists was held in West Virginia from May 27 to 30. More than fifty geologists from New York, New Jersey, Pennsylvania, Virginia and West Virginia attended.

The conference hosts were the members of the West Virginia Geological Survey. The 1939 committee consisted of Dr. Paul H. Price, state geologist of West Virginia, *chairman;* Dr. B. L. Miller, Lehigh University; Dr. R. E. Sherrill, University of Pittsburgh, and M. N. Shaffner, Pennsylvania Topographic and Geologic Survey, secretary and treasurer.

The annual dinner was held at the University of West Virginia at Morgantown on Sunday evening. A welcome was extended to the group by the president of the university, Dr. Charles E. Lawall. Other speakers were, Dr. Paul H. Price; Dr. Arthur Bevan, state geologist of Virginia; Dr. B. L. Miller; Dr. R. W. Stone, Pennsylvania Topographic and Geologic Survey; E. T. Heck, West Virginia Geological Survey; Professor Herbert Woodward, University of Newark, and M. N. Shaffner.

The committee accepted an invitation from the New Jersey Geologists to meet with them in New Jersey in 1940, and the following committee was appointed for that meeting: Dr. Meredith E. Johnson, state geologist of New Jersey, *chairman;* Professor Herbert Woodward; Dr. Bradford Willard, Pennsylvania Topographic and Geologic Survey, and M. N. Shaffner.

On Sunday the excursion covered strata from Lower Mississippian to Upper Pennsylvanian in the area between Morgantown and White Sulphur Springs. On Monday strata from Upper Ordovician to Middle Mississippian were covered between White Sulphur Springs and Petersburg, and on Tuesday strata from Upper Silurian to Lower Mississippian were covered between Petersburg and Berkley Springs. The leaders were Dr. Paul H. Price, E. T. Heck, Herbert Woodward and Professor H. M. Fridley, West Virginia Geological Survey.

M. N. SHAFFNER,
Secretary and Treasurer

SPECIAL ARTICLES

THE RELATION OF "COENZYME R" TO BIOTIN

THE value of yeast or plant extracts as stimulants to growth of the root nodule bacteria (*Rhizobium* sp.) has been long recognized. Allison, Hoover and Burk[1] explained the stimulation on the basis that the extracts provide a specific coenzyme for respiration (Coenzyme R), and concluded that the active agent "is certainly not identical with bios, since its addition to synthetic medium essentially free from bios resulted in growth of yeast negligible compared with the heavy growth obtained where bios was present." Apparently, it has been assumed by many workers that this implies that biotin, a growth factor for yeast, is not a growth stimulant for rhizobia, a conclusion which does not necessarily follow from the foregoing statement.

Evidence obtained in this laboratory strongly indicates a relationship between the growth factor requirements of yeast and rhizobia. Treatment of yeast extract with acids, alkalies, solvents, adsorbents and oxidizing agents resulted in parallel preservation or destruction of the activity for both *S. cerevisiae* and *R. trifolii.*

During preparation of biotin concentrates by the procedure of Kögl and Tonnis,[2] fractions were tested at each stage of purification, and total units and purity of the active factor assayed by growth of *S. cerevisiae* and *R. trifolii.* The concentration of biotin, as assayed by yeast growth, was accompanied by the same degree of purification of the Rhizobium factor, until the norite adsorption step was reached. Unexpectedly, the eluate (biotin fraction) was highly active with *R. trifolii,* but inactive with yeast. On addition of a small quantity of the filtrate, however, the activity for yeast was completely restored. Further investigation disclosed that the filtrate factor could be replaced by synthetic β-analine. Following this lead, a prepara-

[1] F. E. Allison, S. R. Hoover and D. Burk, SCIENCE, 78: 217, 1933.

[2] F. Kögl and B. Tonnis, *Zeits. Physiol. Chem.,* 242: 43, 1936.

tion of "Coenzyme R" obtained from *Azotobacter* by the method of Hoover and Allison[3] was tested, and it was found, in agreement with these workers, that alone it was completely inactive with yeast. When 0.1 gamma per ml of β-alanine was added, however, the preparation stimulated yeast growth in a manner identical with that of the biotin concentrate. For maximum growth response, it required 5 gammas per ml of the former, but only 0.3 gamma of the latter. With a given level of either "Coenzyme R" or biotin concentrate, a maximum in the curve of yeast stimulation was obtained in the region of 0.05 to 0.5 gamma per ml of β-alanine. With *R. trifolii* near maximum stimulation was obtained with either "Coenzyme R" or biotin alone; addition of 0.05 gamma per ml or over of β-alanine gave a small but consistent supplementary effect. It is not surprising that β-alanine is much less effective with *R. trifolii* than *S. cerevisiae* since the former is apparently capable of decarboxylating aspartic acid to form β-alanine.[4] The growth of *R. trifolii* was not decreased when the amount of β-alanine was raised to 1.0 gamma per ml. These results have been confirmed with several species of *Saccharomyces* and *Rhizobium*.

Consideration of these data leads to the following alternative conclusions:

(1) "Coenzyme R" and biotin are identical.

(2) "Coenzyme R" and biotin are distinct, but with such similar chemical and physical properties that we have not been able to separate them by any of the procedures indicated.

(3) "Coenzyme R" and biotin are distinct, but each acts as a growth stimulant for either or both yeast and rhizobia.

Final decision with regard to the relationship must necessarily rest until both factors are available in pure form. However, until a more purified "Coenzyme R" is prepared which definitely shows no activity for yeast even in the presence of β-alanine, conclusion 1 appears to be the simplest assumption. If the two factors are distinct, the present evidence favors conclusion 3, *viz.*, that biotin also is a stimulative factor for *R. trifolii*.

P. M. WEST
P. W. WILSON

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SAND CULTURE[1] OF COTTON PLANTS

THE successful culture of many vegetables and flowers in water, sand, cinders, etc., suggested that this technic might be useful in research on the physiology of the cotton plant. Publications on the subject have been scattered in scientific and lay journals; in those available to us, no references to the culture of cotton plants were found.

Preliminary attempts to grow cotton seedlings by immersion of the roots in nutrient solutions were not successful. However, when the young plants were placed in sand,[2] they grew to maturity. The seeds were germinated between moistened filter papers and when the roots were from 1½ to 2 inches long, each was transplanted to a washed clay flower pot (4-inch diameter) containing wet sand. The sand was kept wet by irrigation twice daily with distilled water. Every third day, the sand was flooded with the culture solution. The solution used was that recommended by the New Jersey Agricultural Experiment Station as described by Ellis and Swaney,[3] and contained the following ingredients[4] dissolved in distilled water:

	Parts per million
$Ca(NO_3)_2$	740
KH_2PO_4	310
$MgSO_4$	280
$(NH_4)_2SO_4$	95
$FeCl_3$	8.5
H_3BO_3	0.85
$ZnSO_4$	0.48
$MnSO_4$	0.46
$CuSO_4$	0.07

The pots were kept on the window sills of a chemical laboratory with southern exposure. On clear days they received approximately two hours of sunshine. Despite these abnormal environmental conditions, growth was steady and fairly rapid. Some plants attained a height of 100 cm in 100 days. In periods of mild weather, numerous squares[5] developed, several of which opened to form the cotton flower. Most of the bolls were shed within two weeks after the flower[6] appeared. In two instances, however, bolls set and developed normally. Although they were small, the seeds were fertile and the lint mature.

The cotton plant may thus be grown successfully under the artificial régime described. Conditions were far from optimal as indicated by the large numbers of shed squares and an abnormally long time required for maturation of the bolls. With a more favorable environment, the method might be used advantageously to study the basic and optimum requirements of the cotton plant. It would be particularly useful in deter-

[3] S. R. Hoover and F. E. Allison, *Trans. 3rd Internatl. Cong. Soil Sci.*, 1: 158, 1935.

[4] A. I. Virtanen and T. Laine, *Enzymologia*, 3: 266, 1937.

[1] The term "psammoponics" to designate sand culture has been introduced by W. A. Hamor, *Ind. Eng. Chem., News Edition*, 17: 1, 1939.

[2] 20–30 mesh standard sand.

[3] C. Ellis and M. W. Swaney, "Soilless Growth of Plants," Reinhold Publishing Co., New York, 1938.

[4] The ferric chloride is made up in a separate solution and added to the medium just before use.

[5] Cotton flower buds.

[6] The flowers last 24 hours.

mining the role of trace elements in growth and fruiting.[7] The optimal ratios of essential elements, such as N:P, could be investigated. Information on the cause of shedding might be obtained.[8] The technic also can be used in studies of plant metabolism.[9]

Thus, this procedure, as a useful method in determining the physiological requirements of the cotton plant, may ultimately be helpful in improving the yield of lint and seed. In the present plight of cotton agriculture, any means for reducing the cost of raising cotton merits especial attention. Lower production expenses, and hence economically sound decreases in price, would stimulate domestic uses and the export trade.[10]

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PHYSICO-CHEMICAL PROPERTIES OF THE ROUS CHICKEN TUMOR AGENT[1]

THE agent causing Rous chicken tumor I may be separated from cell-free tumor extracts by high-speed centrifugation (Ledingham and Gye, McIntosh, Elford and Andrewes, Amies, Claude, Pollard). The purified material serving for the present experiments was prepared essentially according to Claude[2] with the aid of an air-driven ultracentrifuge.[3] The nitrogen content was 8.9 per cent. The material is precipitated from its strongly opalescent solutions by half-saturation with ammonium sulfate and by protamine. It contains thymonucleic acid. Even after four sedimentations in the high-speed centrifuge the material gives a positive hemochromogen reaction. Amounts of 10^{-7} to 10^{-9} gm produced typical sarcomas in chickens. *In vitro* the material exhibited cytochrome oxidase and catalase activity (unpublished experiments with Mr. J. L. Melnick). It remains to be decided whether these enzymatic activities are intrinsic properties of the tumor-producing agent or whether they are due to associated substances.

The solutions of the purified agent show no appreciable flow double refraction. Their relative viscosity is 1.3 in 1 per cent. solutions after complete removal of the highly viscous mucin material present in crude tumor extracts. Measurements by the falling drop method of Barbour and Hamilton,[4] for which we are indebted to Mr. P. H. Barbour, Jr., indicate a density of 1.23. Preparations purified by four alternate high-speed (30,000 r.p.m.) and low-speed (2,600 r.p.m.) centrifuge runs, when examined in the analytical ultracentrifuge by the light-absorption method, yielded a mean sedimentation constant $s_{20} = 550 \times 10^{-13}$ cm dynes^{-1} sec^{-1} (Fig. 1).

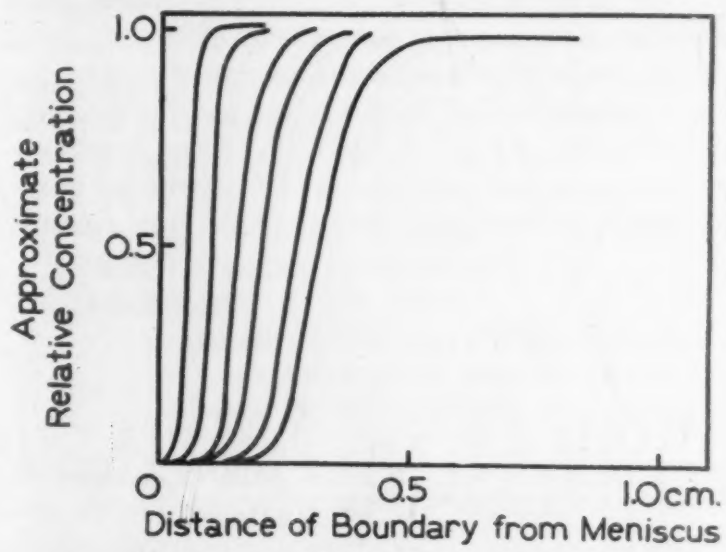

FIG. 1. Tracings of microphotometer curves obtained from sedimentation photographs of purified Rous chicken tumor I agent. Concentration of material, 1.08 per cent., in 0.005 M. phosphate, pH 7.3; mean gravitational force, 3,500 g (7,200 r.p.m.); intervals between exposures, 6 min.; length of exposure time, 5 sec. (Eastman positive film); $\lambda = 2{,}480 - 3{,}600$ Å (high-pressure mercury arc, bromine filter); photographic magnification, 1.5; magnification ratio during recording, 1:6.

The macromolecular material prepared from normal chick embryos according to Claude[5] shares many physico-chemical properties with the Rous chicken tumor I agent. The average sedimentation rate of two purified preparations was found to be $s_{20} = 532 \times 10^{-13}$ cm dynes^{-1} sec^{-1}.

While only one boundary could be observed upon sedimentation of the preparations from chicken tumor I and normal chick embryos the spreading of the boundary in the course of the runs indicated a relatively low homogeneity of the materials. The figures given above represent the sedimentation rates of the particles of average size present in populations of particles of somewhat differing dimensions. The more extensively purified preparations were found to be free

[7] Although the unglazed pots were washed, it is possible that traces of an essential element or elements were slowly leached from them. Growth experiments in glass containers would be more conclusive.

[8] According to Brown, "Even where there are no insects to bother, more than half the flowers that open fail to make bolls that mature." H. B. Brown, "Cotton," McGraw-Hill Book Co., New York, 1938, p. 124).

[9] The root system is easily obtained for analysis by washing away the coarse sand in a stream of water. According to macroscopic observation, no particularly fine root hairs develop. The availability of water and nutrients apparently renders them unnecessary.

[10] It is necessary to give credit to the Cotton Research Foundation (see SCIENCE, 87: 87, 1938). Since this paper was submitted we have learned that sand culture of cotton has been practiced for some time at several southern agricultural experiment stations.

[1] This investigation was aided by a grant from the Jane Coffin Childs Memorial Fund for Medical Research.

[2] A. Claude, *Amer. Jour. of Cancer*, 30: 742, 1937; SCIENCE, 87: 467, 1938.

[3] J. W. Beams, F. W. Linke and P. Sommer, *Rev. Sci. Instr.*, 9: 248, 1938.

[4] H. G. Barbour and W. F. Hamilton, *Jour. Biol. Chem.*, 69: 625, 1926.

[5] A. Claude, *Proc. Soc. Exp. Biol. and Med.*, 39: 398, 1938.

from foreign proteins which are unsedimentable in the gravitational fields employed. There is a marked tendency towards aggregation upon storage at low temperatures.

The calculation of the size and mass of the tumor-producing material from the sedimentation constant and density requires a knowledge of the shape of the particles. The absence of birefringence both in flowing solutions and in the gel-like pellets formed during ultracentrifugation, and, more directly, the observation of round, uniform particles in such preparations upon microscopical dark-field examination (Ledingham and Gye, McIntosh, Amies, Claude) indicate a symmetrical shape of the agent, in spite of the relatively pronounced viscosity of its solutions. The application of Stokes's equation for spherical particles yields a mean value for the diameter of the particles of 70 mμ. This, in turn, leads to values for the average weight of the individual particles of 2.3×10^{-16} gm and for the average "molecular weight" of 139×10^6. These figures are in close agreement with the results secured by ultrafiltration[6] and non-optical centrifugation[7] experiments.

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ON THE NATURE OF THE AGENT CAUSING LEUCOSIS IN FOWLS[1]

THE work of Ellerman, Furth and others has shown that fowl leucosis, in contrast to mammalian leukemia, can be transmitted by cell-free plasma and tissue extracts. The virus strain used in the present investigation was Strain No. 1 of Dr. J. Furth, to whom the authors are greatly indebted for the supply of original donor material. Fifty per cent. of the chickens inoculated intravenously with whole blood and 28 per cent. of those inoculated with whole plasma developed the disease.

Centrifugation of heparinized leucotic plasma in the chilled quantity rotor of an air-driven ultracentrifuge[2] for 30 to 60 minutes at 23,000 r.p.m. (gravitational force at the bottom of the tubes, 37,400 g) yielded a small, colorless flaky sediment in addition to a yellow, translucent jelly-like pellet. Suspension of the sediment in M/15 phosphate buffer (pH 7.3), after removal of aggregated matter in the horizontal centrifuge, gave an opalescent solution showing a pronounced Tyndall effect. Pellet solutions prepared from active plasma have produced leucosis in 3 out of 11 chickens after intravenous injection.

Marrow of the long bones provided a richer source of the macromolecular material. Upon grinding frozen leucotic bone marrow with sand, extraction with 0.005 M. phosphate (pH 7.4) and removing cell debris in the horizontal centrifuge (2,600 r.p.m.), strongly opalescent solutions were obtained. These produced leucosis in 4 out of 10 injected chickens. When such crude marrow extracts were subjected to ultracentrifugation at speeds ranging from 23,000 to 30,000 r.p.m. (max. gravitational force, 37,400 to 63,300 g), substantial pellets were obtained containing all the material responsible for the strong opalescence of the crude extracts. The material was purified by resuspending it in 0.005 M. phosphate (pH 7.4), removal of aggregated matter by low-speed centrifuging (2,600 r.p.m.), resedimentation of the macromolecular material in the ultracentrifuge (30,000 r.p.m.) and repetition of the entire procedure. The average yield of macromolecular material after four ultracentrifugal sedimentations was 11 mg from 1 gm of bone marrow. Only traces of macromolecular material were obtained from normal bone marrow under the same conditions.

Material prepared in this manner from leucotic bone marrow has produced leucosis in 4 out of 19 inoculated chickens. The remaining 15 birds are still under observation. With the exception of one instance, where contamination with pellet material could not be excluded, supernatant solutions from both plasma and bone marrow ultracentrifuge runs were inactive (20 chickens). It should be mentioned that although microscopic examinations of pellet material have definitely excluded the presence of cellular material in a few tests, in other instances cellular debris was observed. It remains to be determined whether this material might be responsible for some of the positive results obtained.

Purified macromolecular bone marrow material contains about 9.5 per cent. nitrogen. Color reactions for thymonucleic acid are positive. Hemin can be demonstrated by the pyridine hemochromogen test. The material possesses cytochrome oxidase and catalase activity (unpublished experiments with Mr. J. L. Melnick). It remains to be determined whether these enzymatic activities are due to the agent itself or to small amounts of associated substances.

In the analytical ultracentrifuge the material sedimented with a single boundary which tended to spread during the course of the runs, indicating a relatively low degree of inherent homogeneity. From microphotometer tracings (Fig. 1) obtained from sedimentation photographs of bone marrow material purified by four ultracentrifugations an average sedi-

[6] W. J. Elford and C. H. Andrewes, *Brit. Jour. Exp. Pathol.*, 16: 61, 1935.

[7] W. J. Elford and C. H. Andrewes, *Ibid.*, 17: 422, 1936; J. McIntosh and F. R. Selbie, *ibid.*, 18: 162, 1937; A. Claude, *J. Exp. Med.*, 66: 59, 1937.

[1] This investigation was aided by grants from the Jane Coffin Childs Memorial Fund for Medical Research and the Fluid Research Fund of the Yale University School of Medicine.

[2] J. W. Beams, F. W. Linke and P. Sommer, *Rev. Sci. Instr.*, 9: 248, 1938.

mentation constant $s_{20} = 582 \times 10^{-13}$ cm dynes^{-1} sec^{-1} has been calculated. On the assumption that the particles possess spherical shape, which is supported by the absence of flow double refraction and by the low relative viscosity of their dilute solutions (1.09), the average diameter of the individual particles, as derived from the sedimentation constant with the aid of Stokes's equation, is 72 mμ. Using the value of 1.22 for the density of the material (kindly determined for us by Mr. P. H. Barbour, Jr., by the falling drop method of Barbour and Hamilton) an average particle weight of 2.6×10^{-16} gm and a "molecular weight" of 146×10^6 is obtained.

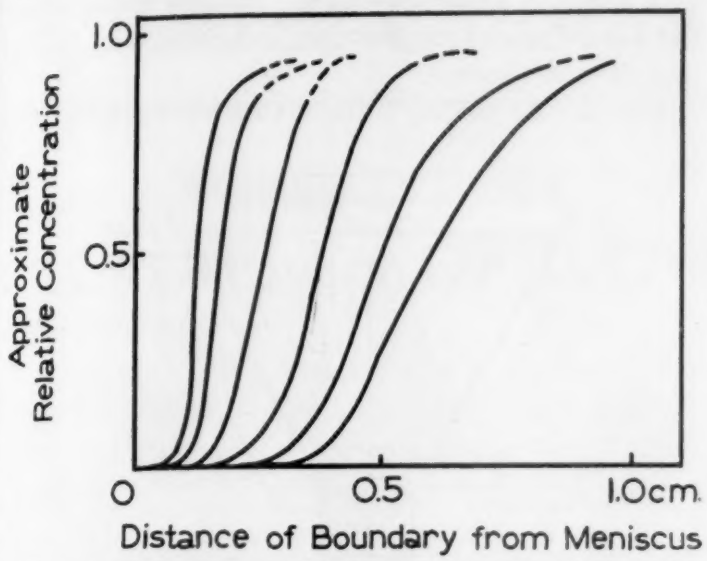


FIG. 1. Tracings made from the microphotometer curves of the sedimenting boundary of macromolecular material isolated from bone marrow of leucotic chickens. Material purified by four alternate high-speed (30,000 r.p.m.) and low-speed (2,600 r.p.m.) centrifuge runs; concentration, 0.5 per cent., in 0.005 M. phosphate (pH 7.4); mean gravitational force during analytical run, 3,500 g (7,200 r.p.m.); interval between exposures, 6 min.; $\lambda = 2{,}480 - 3{,}600$ Å; photographic magnification, 1.5; magnification ratio during recording, 1: 6.

With respect to its chemical and physical properties the material described above resembles the causative agent of the Rous chicken tumor I[3] and also the macromolecular material isolated by Claude[4] from normal chick embryos. In contrast to the virus proteins isolated by Stanley and others from plants, these materials do not represent pure nucleoproteins but much more complex chemical structures of the type encountered in the analysis of protoplasm.

KURT G. STERN
ARTHUR KIRSCHBAUM
LABORATORY OF PHYSIOLOGICAL CHEMISTRY
AND DEPARTMENT OF ANATOMY,
YALE UNIVERSITY SCHOOL OF MEDICINE

SCIENTIFIC APPARATUS AND LABORATORY METHODS

THE SIMPLEST TRANSPARENT ULTRACENTRIFUGE

WE have developed a form of transparent ultracentrifuge which permits of photographic recording of the contents of a glass or quartz tube while spinning at 110,000 times gravity. It is so simple that it dispenses entirely with accessories, not even a camera being required. The complete equipment can be made in fifty to sixty hours of a mechanician's time. Nevertheless, it gives useful results of fair accuracy.

The device is a development of ideas previously used by Elford, McIntosh and Selbie, and Ford, but applied to obtaining a record without stopping the rotor. This consists, Figs. 1 and 2, of a solid piece of duralumin, 7 cm in diameter, and directly air-driven. In the upper surface two channels are milled on the same diameter; one carries a dummy to balance the cell. In the other is placed first a piece of photographic film and upon it a block of hard rubber with a horizontal hole to hold a tube of 1.5 mm internal and 7 mm external diameter, containing the solution to be measured. The rubber block is sawn nearly in two, giving a radial vertical slit 0.6 mm wide. The tube is sealed at the outer end and closed at the other end with a piece of gummed paper with a piece of cork pressing against it to assist insulation. The length of column of liquid we have used is 8 mm, but may readily be longer. It therefore has ample resolving power for the smallest proteins. The rotor has a cover screwed on with a central screw. In the cover is a window, set in with Duco or similar

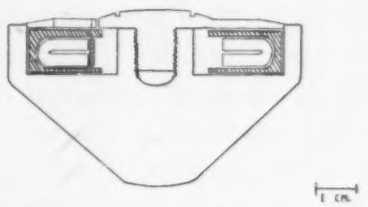


FIG. 1. Cross section through assembled rotor.

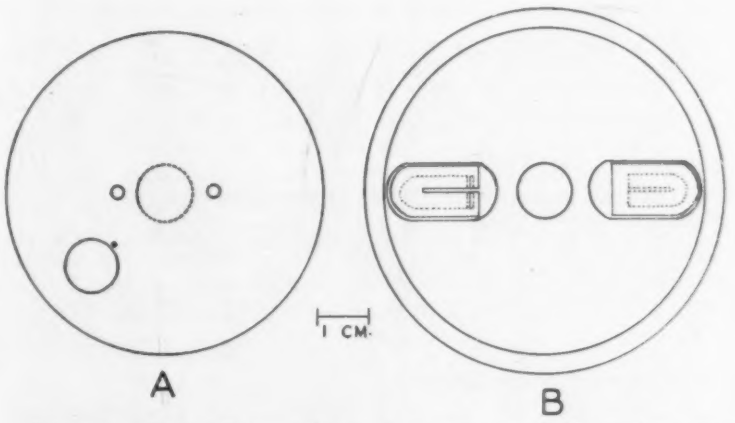


FIG. 2. View from above, A, cover, and B, rotor containing cell and dummy.

[3] K. G. Stern and F. Duran-Reynals, SCIENCE, 89: 2322, 609, 1939.

[4] A. Claude, *Proc. Soc. Exp. Biol. and Med.*, 39: 398, 1938.

nitrocellulose cement. There is also a hole 0.5 mm in diameter just next to the window nearer the axis of the rotor to serve as reference point. About 30 cubic feet of air are required per minute if the pressure is 100 pounds per square inch. The stator should also be 7 cm in diameter.

The run is made in dim light or with a cover placed over the guard around the rotor until the record is desired, whereupon a distant light or a collimated beam is flashed on for about one second. This places upon the photographic film a spot representing the reference point, a boundary for the top of the tube or edge of the window, another for the liquid meniscus and a graduated image showing any boundary or optical inequality in the liquid from top to bottom. Only one record has been made for each run, but it should be easy to arrange a slit or opening which can be moved outwards to successive positions, and exposed in each.

This was developed for the study of petroleum products in non-aqueous solution, but we quote here some test runs on sedimentation velocity in earthworm blood diluted 10:1 with 1 per cent. potassium chloride solution. These can be made at the rate of several an hour, owing to the fact that the direct air-drive brings the rotor to full speed almost immediately, so that zero time can be taken when the air is full on. Instead of one tube, two to six can be measured simultaneously in the same rotor.

The duration of each sedimentation was 5 minutes. The values of sedimentation constant $s \times 10^{13}$ were successively 58.2, 57.7, 58.9, 55.5, 57.6, 53.7, 60.8; which, reduced to 20° C., become 59.2, 60.0, 61.0, 57.9, 60.0, 55.9 and 63.4. The mean is 59.6. Svedberg's values for s20° were from 56.4 to 64.3, mean 60.9.

The cylindrical tube is of course not radial, but this is of very minor importance. There is a controlled convection outwards, confined to within a few particle diameters of the periphery of the tube with the correspondingly small upward movement of all the remaining volume, thus giving a sedimentation velocity very slightly too small, as in the example given. If desired, the usual type of radial sectorial cell may be used. A detailed description of the rotor and stator will be published elsewhere.

It would appear that the ultracentrifuge in this form could now be made available for undergraduate classes in biochemisty and colloids.

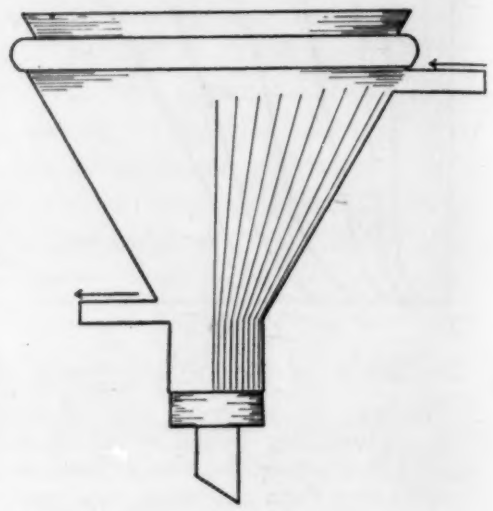
J. W. McBAIN
A. H. LEWIS

STANFORD UNIVERSITY

FUNNEL-HEATING DEVICE

WITH the necessity for frequently conducting hot filtrations has arisen the need for more efficient and practical means of keeping funnel contents hot than is afforded by older forms of funnel-heating devices. These forms, whether of coils or double-wall jackets, lack satisfactory heat transfer, making it difficult to keep alcoholic solutions boiling. There is also a serious fire hazard where gas heat has to be applied to maintain the temperature.

The present device, a front view of which is illustrated, consists of a single-wall metal jacket, which fits around the bell of a funnel and makes steam-tight connections by means of a rubber gasket at the top and a bored rubber stopper on the stem. The compressive stress in the rubber keeps the device locked tightly against the glass so that no leakage of steam occurs. Inlet and outlet nipples are provided for the steam. Since the steam impinges directly against the outer surface of the glass funnel, the heat transfer is at its maximum efficiency, and alcoholic solutions can be kept at the boiling point. If a steam line is not available, the device can be operated satisfactorily with steam generated in a flask on the laboratory table. Among other desirable features are the transferability from funnel to funnel, use with funnels considerably larger than the device itself and rugged construction. The device is patented and is now on the market.



FUNNEL-HEATING DEVICE

FIG. 1

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SCIENCE NEWS

Science Service, Washington, D. C.

DETECTING DEVICE FOR COSMIC RAYS

THE largest detecting device ever built for the study of cosmic rays was announced at the meeting of the American Physical Society, in New York City, by Dr. W. F. G. Swann, director of the Bartol Research Foundation of the Franklin Institute.

The device is essentially a ten-story "apartment house" consisting of ten tiers of Geiger-Muller cosmic ray counters arranged in banks, with 18 to each tier. The 180 separate devices enable scientists to detect the passage of cosmic rays and to see how they may produce multiple collisions.

Each Geiger counter is connected to its own electroscope which registers the passage of a cosmic ray through each individual counter. Tiny beams of light from the leaves of each electroscope are sent, by intricate mirror systems, to a large ground glass screen on which appear 180 spots of light. As a cosmic ray goes through the entire apparatus many of these little light spots oscillate back and forth. By taking automatic photographs of the passage of each cosmic ray scientists obtain pictures of the actual paths of the rays through the apparatus. The visible effect is something like looking at the side of a skyscraper with all its many windows lighted and then noticing that certain of the windows have their lights flickering.

In the apartment house of Geiger counters—which is about five feet high over all—the "roof" consists of ten centimeters of lead. Each floor of the pile consists of one centimeter of lead. The large thickness of lead insures that only the most penetrating cosmic rays will pass through the apparatus and make the counters record. Moreover, to insure still greater sorting out of the less penetrating cosmic rays, the whole device stands under a large tower containing 30 feet of water. Thirty feet of water corresponds to the same amount of material as is contained in a vertical column of air right up to the top of the earth's atmosphere. Thus the water column, in effect, enables scientists to double the earth's atmosphere, for purposes of their measurements.

It is possible with the apparatus to see how a single cosmic ray passes through the entire apparatus from top to bottom and to see also how it sometimes is changed from one into two particles. These "progeny" of the parent particle may, in some cases, also become parents and so on. Thus the new device acts in many ways like a robot "census taker" for cosmic rays, keeping track of their "birth rate" and enabling scientists to compute a sort of "mortality table" for their life and death.

The usual birth and death of cosmic ray particles in the atmosphere is not too frequent, but when they are made to pass through the huge water tower and then through the additional lead the production of cosmic ray offspring is greatly increased. In effect the scientists are speeding up the "evolution" of impacts produced by cosmic rays.—ROBERT D. POTTER.

THE MEASUREMENT OF THE INNER ATOMIC BINDING FORCE

FOR the first time the value of the enormous electrical binding force within the cores of atoms which enables the matter of the visible world to hold itself together instead of disintegrating into simple atoms of gaseous hydrogen has been measured exactly. This inner attractive binding "cement" of the universe is a force which is equivalent to 11,000,000 electron volts. It acts only when the protons—the building blocks of the atoms—come within one tenth of a millionth of a millionth of an inch apart.

The new quantitative measurement of the nuclear force was described in reports to the American Physical Society by Professors Gregory Breit and Raymond G. Herb, and Drs. D. W. Kerst, D. B. Parkinson, G. J. Plain, H. M. Thaxton and L. Eisenbud, of the University of Wisconsin.

The new Wisconsin studies are an extension of the work by Drs. M. A. Tuve and L. R. Hafstad and their colleagues of the Carnegie Institution of Washington, which earlier led to the discovery of the basic binding force within atomic nuclei.

These earlier experiments studied the reactions of protons, scattered by other protons, over the energy range from 600,000 to 900,000 electron volts. The new work at Wisconsin, using the electrostatic "atom smasher" of that laboratory, has extended the range of measurement from 850,000 to 2,400,000 electron volts energy. This amounts to the widening of the experimental field of study by a factor of from four to five times.

Simultaneously with the Wisconsin tests has been a repetition of the study of the lower energy range at the Carnegie Institution, which has a higher order of accuracy than their original experiments. The two sets of independent data supplement and confirm one another and have made possible the new and better fixation of the energies present in the nuclear force and the distance, within the atom, over which it acts.

"HEAVY" WATER

PROGRESS in explaining some of the mysteries of heavy water, which has a density 10 per cent. greater than ordinary water, was reported by Drs. Victor K. LaMer and Evan Noonan, of Columbia University, at the symposium on intermolecular action of the American Chemical Society at Brown University.

Instead of using ordinary water in batteries, heavy water was used and it was found that the electromotive force was increased by 4.4 thousandths of a volt.

Dr. LaMer explained that it will now be possible to measure the exchange of hydrogen for deuterium—the heavy double weight kind of hydrogen—which takes place in the formation of heavy water. He said: "Up until the completion of our investigation, this change of atoms was measured by the resulting chemical properties. Such chemical measurements are not as accurate as those performed electrically.

Determination of Mercury

REAGENT— s-Diphenylcarbazide

METHOD— Colorimetric

REFERENCE— Laird and Smith, *Ind. Eng. Chem., Anal. Ed., 10,* 576 (1938)

THE ACCURACY of mercury determinations made colorimetrically with s-diphenylcarbazide is confirmed by the work of the above authors. The maximum color is formed in 15 minutes and is stable for several hours. Control of the acidity is shown to be essential. An abstract of the procedure recommended will be forwarded upon request.

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"The results of our experiments also furnish an explanation as to why heavy water is separated from light water during electrolysis. A very small per cent. of heavy water is present in all ordinary water. In order to separate the two constituents, an electrical charge is run through the water by means of two submerged metal poles called electrodes. The hydrogen ion in the ordinary water takes on an electron from the negatively charged electrode and goes off in the form of hydrogen gas. In order for a similar reaction to occur in the deuterium ion, an electric force 44 thousandths of a volt stronger is needed. The hydrogen, therefore, is driven off first leaving behind heavy water with its deuterium content.

"Previously, it was thought that the amount of electrical force necessary to change the deuterium ion into deuterium gas was only four millivolts, or 4 thousandths of a volt, greater than that required for hydrogen. The real explanation of how heavy water is separated comes out more clearly when the new measurements are taken into consideration."

MEASUREMENT OF THE MILKY WAY

A NEW measurement of the dimensions of our own island universe, the Milky Way, was presented to the American Astronomical Society, meeting in New York City, by Dr. Harlow Shapley, director of the Harvard Observatory.

By study of the useful cluster-type Cepheid variable stars, whose distances can be readily determined, Dr. Shapley found that the globe of stars surrounding the dense disc of the Milky Way is more than 60,000 light years thick. Dr. Shapley stated that the most distant objects of this globe are farther away than the Magellanic Clouds, our satellite galaxy neighbors. Thus, these external systems may, in a tenuous way, be said to lie within the globe of stars that constitute the outer fringes of the Milky Way. Probably 95 per cent. of all known stars, whether variable or not, are within a thousand light years of the Milky Way plane. But the observed cluster-type variables extend outward from that plane to distances of 50,000 light years or more. Evidence that the extremely distant Cepheids are part of the Milky Way system lies in the fact that the "population density" of these stars, or the average number of stars per unit volume of space, falls off rapidly at greater distances from the Milky Way.

At a distance of 30,000 light years from the plane the density is about one thousandth of that near the plane, Dr. Shapley said. Clearly then the stars are members of our system, and do not represent a random distribution of stars through space.

Dr. Shapley studied the several hundred cluster-type Cepheid variable stars lying in the high galactic latitudes, that is, quite far from the Milky Way plane, and free from the low-lying absorbing clouds which make measurement of distances difficult. Most of the high latitude stars were found in surveys of faint variables carried on at the Harvard Observatory.

COMPOUNDS OF FLUORINE

COMPOUNDS of the corrosive gaseous element fluorine as the materials which are able to produce thin films on optical glass that will increase the transmission ability to 99.6 per cent. was announced by Drs. C. Hawley Cartwright and A. Francis Turner, of the Massachusetts Institute of Technology, to members of the American Physical Society, meeting in New York City.

Simple compounds of fluorine with lithium, magnesium, calcium and sodium all produce thin films which give the amazing optical property of increasing transmission through glass optical parts.

The discovery is of great importance in all complex optical instruments like cameras, spectrographs and periscopes where many prisms and lenses are employed and where each glass-to-air surface shows a loss of light due to reflection. The use of the new films, which are evaporated on to the glass in the research, decreases such reflective losses.

At first sight it seems paradoxical that the placement of anything on a transparent optical surface, be it a film ever so thin, could possibly increase the transmission of the optical glass. And yet this is accomplished in the new scientific advance.

Light incident on a piece of glass is ordinarily split into two parts. The major part goes through the glass and is transmitted. The other, smaller part is reflected at the surface, comes backward and is lost for transmission purposes. However, if a film of magnesium fluoride, for example, is placed on the surface of the glass, the length of the reflected light waves can be so altered that they will vibrate just out of phase with the oncoming wavetrains of the incident light. By suitable adjustment of the reflected light pattern the incoming waves can be made to cancel the reflected waves and the reflection, instead of being five or ten per cent., can be reduced almost to zero. The crucial point is that this light energy, which has been annulled by the interference effect, is not lost but reappears in the transmitted beam of light and shows up as an increase in transmission.

The films used have thicknesses about one quarter the wave-length of a ray of green light in the visible spectrum. The films themselves are invisible and can only be seen by the brilliant colored patterns they produce by interference in quite the same way that a thin film of oil on a mud puddle will show iridescent colorations.

The announcement coincides with that of scientists at the General Electric Company, who have reported the use of what has been termed a thin "varnish" film for coating glass to obtain comparable transmission properties. The composition of the "varnish" film was not announced.—ROBERT D. POTTER.

HIGH PRESSURE AND CHANGE OF COLOR IN ORGANIC SOLUTIONS

FOR the first time strong color changes have been produced in organic solutions by the mere application of high pressures, it is reported by Drs. R. E. Gibson and O. H. Loeffler, of the Geophysical Laboratory of the Carnegie Institution of Washington, to the symposium on intermolecular action of the American Chemical Society at Brown University.

The discovery of solutions in which there is found no evidence of chemical compound formation in the usual

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sense, raises new questions about the origin of color. For a long time it has been known that when faintly yellow nitrobenzene and colorless aniline are mixed, a deep orange color is produced. But the newest discovery is that when pressures of 1,000 atmospheres (roughly 15,000 pounds to the square inch) are applied to such solutions they change their color markedly, becoming more red as the pressure increases. So new is the work of Drs. Gibson and Loeffler that the absorption spectrum of the colored solution has not yet been measured in detail. But the color change with pressure can readily be seen with the eye aided by a light filter. Moreover, the change can be confirmed by photographing the spectrum and showing that the light transmitted by the solution decreases as the pressure increases.

The implications of the new discovery strangely link pressure, ordinarily considered a purely mechanical happening, with color, which is known to be intimately bound up with happenings within molecules and atoms. Whether practical applications of the new knowledge will be realized is still a speculative matter. One might picture the possibility, however, that color changes would provide a quick, easy method of estimating pressure changes in high pressure apparatus or devices.

What occurs in the solution of nitrobenzene and aniline when the pressure is applied is still a matter of speculation at present. What may happen is that the pressure increases the number of times a second the aniline molecules bump into the nitro groups, thereby increasing the number of times temporary formation of unstable compounds may occur. These unstable aggregates may account for the color of the solution. A tentative, preliminary hypothesis might suggest that the movements of electrons between the aniline and nitrobenzene in this temporary union could occur so quickly that the color change could occur during the much slower time of actual impact between molecules.

Whatever the actual facts of the strange color phenomena may turn out to be, a curious kind of intermolecular behavior has been found. Further research may throw more light on the subject and perhaps explain it sufficiently to bring new knowledge of the origin of color in nature.

ITEMS

How he has given blood type tests to mummies of Aleut people who lived, and died, and dried up in the Aleutian Islands off Alaska, long ago, was reported by Dr. P. B. Candela, of Brooklyn, to the American Anthropological Association. Dr. Candela said that he detected the blood types of the Aleuts by making chemical tests of ground-up bone specimens from mummies of 30 pure-blood Aleuts. The mummies were among those discovered by Smithsonian Institution expeditions. The four types, or groups, of human blood, which have gained public notice in court tests of paternity, have use in scientific studies of human races. Widely separated tribes and peoples may belong predominantly to one blood group, which may prove to have significant meaning for the origins and history of human races. The Aleuts differ from any North American Indians in that some have blood in the group called B. One fifth of the Aleut mummies that he tested belong in this group. This finding fits in with the view of anthropologists who usually class Aleuts and also Eskimos separately from the Indians who peopled the rest of America.

CENTRIFUGAL dust collectors were described by C. B. Shepherd and C. E. Lapple, of E. I. du Pont de Nemours and Company, before the symposium on fluid dynamics of the American Chemical Society, meeting in Pittsburgh. Commonly they are known as "cyclones." The tornado dust traps are really two whirling spirals of air, one inside the other and traveling in opposite directions. In the dust traps a stream of air rotating at high velocity moves downward. When it reaches the bottom of the device it is turned upward and comes back inside the outer air stream, whirling all the while. The action of these counter-flowing air streams is now being used to trap particles only 4 ten-thousandths of an inch in diameter.

DR. A. I. HALLOWELL, of the University of Pennsylvania, speaking before the American Anthropological Association, stated that ink blots can be used by science as a key to what goes on behind the Indian's impassively calm face. By showing a set of ten ink blots, as a psychology test, to Indian chiefs, conjurers, good hunters and bad hunters, and other types, he found that the Indians' remarks as to what the blots look like provide natural and significant clues to Indian thoughts and emotions. The ink blot test, devised by a Swiss psychologist, has been successfully used with mental patients and criminals, as well as with normal people.

MEASUREMENTS of the electric forces exerted by molecules, which constitute in effect little magnets, are bringing out new facts about the relationships between molecules in liquids, according to a report to the symposium on "Intermolecular Action" sponsored by the American Chemical Society at Brown University. Many molecules, explained Professor Chas. P. Smyth, of Princeton University, can be regarded as having their electricity so arranged as to form positive and negative poles. In this respect they resemble magnets. The more powerful the pole, and the greater the distance between them, the stronger the force exerted by thm on surrounding charged materials. This force is called the "dipole moment" of the molecule. The dipole moment explains the structure of molecules and its measurement and is one of the best ways of interpreting molecular structure.

A STRANGE and as yet unexplained phenomenon occurring in the process of vaporization of a liquid or solid was described by Professor Joseph E. Mayer, of the Johns Hopkins University, at the symposium at Brown University. It has been discovered that instead of changing immediately into the gas "phase" familiar to chemists, every substance, even though composed of the same single kind of molecule will, at a "critical region" of temperature and volume, apparently become two different gaseous materials. These two components do not mix readily and differ in that one of them is denser or heavier than the other and stays in the bottom of the vessel.

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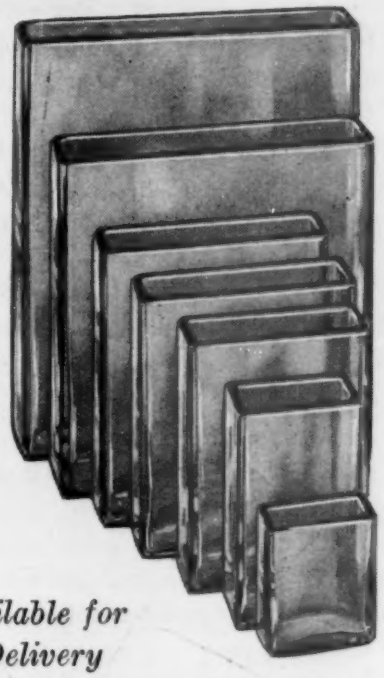

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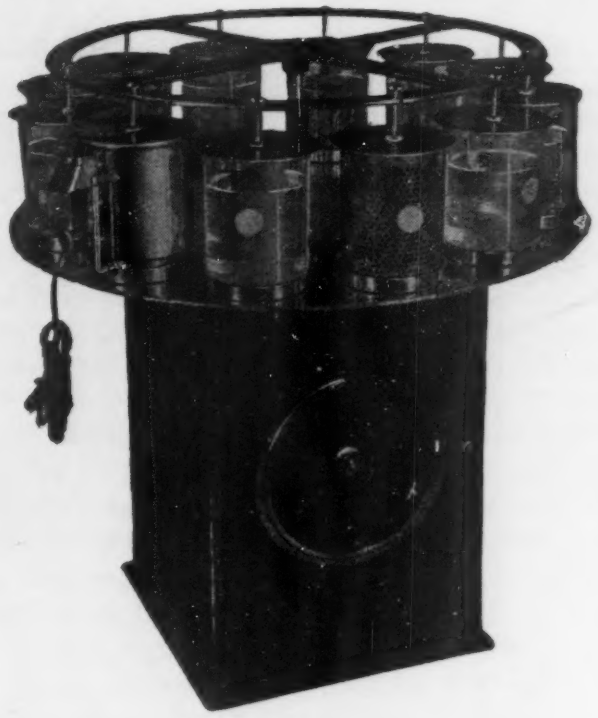

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SCIENCE NEWS

Science Service, Washington, D. C.

CONTENT OF HYDROGEN IN THE SUN

THE sun's content of hydrogen, its chief source of energy, is sufficient to last for 35,000,000,000 years at the present rate of production, according to a report made by Professor H. A. Bethe, of Cornell University, in the *Physical Review*.

Hydrogen is the only element consumed in any quantity in the chief atomic reaction that serves to light the sun and provide the source of its radiation. At present it makes up approximately 35 per cent. of the sun's weight.

A complicated atomic reaction among carbon, nitrogen and hydrogen, which ends in the production of carbon and helium, is the energy source. Though hydrogen is used up, helium is created and neither carbon nor nitrogen are consumed in any quantity. Energy is produced in the process. Only this reaction, outlined by Professor Bethe, produces an amount of energy that agrees with observations of the solar output. All other possible atomic reactions, he indicated, produce either far too little or far too much energy.

The energy-producing reaction takes place in four steps. First, carbon and hydrogen combine to produce an isotope of nitrogen with atomic weight 13. This is unstable and breaks down to form an isotope of carbon with the same atomic weight, 13, and the release of a positive charge of electricity.

The carbon 13 then combines with another hydrogen nucleus to form nitrogen. The nitrogen adds still a third hydrogen nucleus, producing an isotope of oxygen whose atomic weight is 15. But this is unstable and breaks down into nitrogen of atomic weight 15, releasing another charge of electricity. The nitrogen 15 adds a fourth hydrogen nucleus, breaking up into carbon and a helium nucleus.

THE PLANET VENUS

THE brilliant planet Venus owes its luminous splendor in the night sky to an atmosphere of tiny dust particles which scatter sunlight much more effectively than do the air molecules of the earth's atmosphere. This tentative conclusion was advanced at the New York meeting of the American Astronomical Society by Drs. E. C. Slipher and James B. Edson, of the Lowell Observatory.

Taking more than 500 pictures of Venus over a period of eight days late in November, when the planet was at its nearest approach to the sun, an entire ring of light extending around the planet when it was in its crescent phase like that of the moon at first or last quarter, have been photographed.

"Photometric measurements gave the ratio of brightness of the Venus twilight extensions to the brightness of our adjacent sky. Assuming the effective height of the Venus atmosphere as two miles, the brightness of the twilight extensions in the neighborhood of the theoretical cusps is between 35 to 40 times the brightness of our sky near the sun. Since the brightness of our sky in this region is probably about 4,000 lamberts, the brightness of the Venus atmosphere viewed tangentially appears to average more than 100,000 lamberts."

This extreme brightness appears to be due to fine dust particles scattered through the gaseous atmosphere of Venus. Observations through spectroscopes have never revealed the presence of water vapor in the atmosphere of the planet. Such water vapor particles would be the next most likely source of light scattering which could account for the amazing sky brilliance on the planet.

The actual surface of Venus, Drs. Slipher and Edson noted, is never seen because of the overlying dust-filled atmosphere with its light-scattering properties.

A SYNTHETIC SPEAKER

A SYNTHETIC speaker, whose voice never issued from a human throat, actually talked back recently at the bidding of an operator punching a keyboard in a unique demonstration in Philadelphia of electrical wizardry.

Its voice entirely the creation of electrical currents under the operator's control, "Pedro," as its Bell Telephone Laboratories inventors have dubbed it, thrust questions at its audience and parried their queries in turn in tones put together by a collection of vacuum tubes and the like.

The speaker was exhibited at the Franklin Institute on January 5 and for newspapermen earlier in the day, and the instrument is being made ready for lecturing at the New York and San Francisco fairs. One unit will be sent to each coast.

All its parts, with the exception of ten keys, the arm rest and foot pedal, according to H. W. Dudley, R. R. Riesz and S. S. A. Watkins, are in every-day telephone use.

The Voder, proper technical name of the machine, is in reality much like a radio receiving set in that it converts electrical currents into sound. But it differs in that the pattern of the electric wave is not controlled by other sounds, as in a radio transmitter, but by an operator punching the keyboard.

Its nickname, "Pedro," is a reference to Dom Pedro, emperor of Brazil in 1876. In that year Dom Pedro was shown one of the first telephones, on exhibition at the Centennial Exposition in Philadelphia. Asked to listen while some one spoke into a transmitter a few hundred feet away, he exclaimed, "My God! It talks!"

"Pedro" consists of the keyboard and current-producing units, which rest on a small table, and an amplifier to boost the tiny streams of electrons to currents powerful enough to excite a loudspeaker. The voice is actually slightly flat since, for the sake of clarity, unessential overtones are eliminated. The operators, selected from a corps of more than 300 telephone operators and given special training, are able to carry on ordinary conversation, but have not yet worked out sound combinations required for more complex words and ideas.

The Voder, the first machine in the world to create speech, is the result of fundamental research in telephony carried on in the Bell Laboratories. Mr. Dudley in the

course of one of these researches developed a speech synthesizer which could be controlled electrically by a speech analyzer.

When the Bell System exhibits were projected for the expositions in New York and San Francisco, the synthesizer part of the apparatus seemed to offer possibilities for development into a novel display. Through its use, it was felt, the formation of speech sounds could be shown. Mr. Dudley and Mr. Riesz thereupon constructed a model which was put into form for exhibition by W. A. MacNair, also of the laboratories' staff. Mr. Watkins then undertook to work out its linguistic possibilities and a technique for its operation, as well as a course of training for the operators who would have to make the Voder speak its piece in public.

Twenty-three different sounds are available to the operator who, by pressing the keys, sends an electrical current of a particular pattern through the apparatus. This pattern corresponds very closely to the current pattern that would be created if analogous sounds were actually spoken into a transmitter.

The instrument's repertoire is not confined to the tone of the human voice at all. Bleating of sheep, lowing of cattle, grunting of pigs and even the rat-a-tat of the woodpecker can be produced with perfect realism.

PROPOSED INSTITUTE FOR RESEARCH ON NERVOUS AND MENTAL DISEASE

SURGEON-GENERAL PARRAN, U. S. Public Health Service, wants Congress to appropriate more money for the fight on syphilis and other venereal diseases. In his annual report he recommends an annual appropriation for this purpose of $25,000,000.

Establishment in the Federal Health Service of a neurological institute for laboratory and clinical investigations of mental and nervous diseases is also asked.

His third recommendation is for establishment of a special unit in the National Institute of Health for study of chemical remedies for diseases. Such studies, already made on a small scale, have resulted in development of new sulfanilamide compounds. The increasing usefulness of such remedies in treatment of a wide range of diseases indicates the need for further investigations along this line.

Surveying the work of the U. S. Public Health Service, including the National Institute of Health and the National Cancer Institute, Dr. Parran said:

"A greater advance has been made in public health in the United States during the past two years than ever before within a comparable period."

The health of the country was generally good during the period covered by the report, he found. The general death rate for the calendar year 1937 was 10.9 per 1,000 population as compared with 11.3 for the preceding year. For the first six months of 1938, at which point the report concludes, the death rate was still lower, 10.8 per 1,000 population. Deaths of mothers and infants also showed a decided decrease during this period.

In spite of this favorable health record, Dr. Parran says "it is a matter of grave concern" that about 40,000,000 people in the United States are unable to provide themselves with adequate medical care during serious illness and that in the country as a whole there is a deficiency of 360,000 hospital beds, including facilities for care of mental and tuberculous patients.

Dr. Parran's report shows that the Federal Health Service has carried on its health-protecting activities over a very wide range. Specific fights have been pushed on syphilis, cancer, infantile paralysis, Rocky Mountain spotted fever, typhus fever, Weil's disease, trichinosis, scarlet fever, leprosy, heart disease, mottled enamel of teeth and health hazards in pottery, granite, lead storage batteries, fur and manganese industries.

In addition to these specific disease fights, much assistance and technical supervision has been given to state and local health administrations for their improvement. Stimulated by federal grants-in-aid, the state and local appropriations for public health purposes have increased $8,000,000 annually.

THE HEALTH MENACE OF DUST

DUST as a menace to the health of American workers is by no means limited to silica dust and the disease, silicosis, it appears from the report of Daniel Harrington, chief of the health and safety branch of the U. S. Bureau of Mines. The dust problem is used largely as a racket, Mr. Harrington charged, when it should be an operating and engineering problem.

More than 1,000 lives have been saved every year in coal mines during the twenty-seven years that his bureau has been in existence, Mr. Harrington said. He estimated that about 50,000 non-fatal accidents have been prevented annually.

The health menace of dust includes not only silica dust but also bituminous or anthracite coal dust, or dust of iron ore, limestone, alumina or any other mine dust or all combinations of those dusts.

"The dust problem," Mr. Harrington stated, "at least in and around mines, both as regards health and safety in coal mining and as regards health in non-coal mines, is or should be almost entirely an engineering and operating problem. It now is used largely as a type of racket in which the victims of dust disease get little or no relief, financial or otherwise, yet the mine operators, chiefly through their own sins of omission, are harassed by lawsuits or foolish regulations. Moreover, well-meaning but poorly informed law-making bodies or investigation committees promulgate regulations or laws on dust disease, chiefly with reference to silicosis, an ailment all but impossible of anything like accurate diagnosis, when, as a matter of fact, no definite data are available as to numerous essential factors, among them the kind of dust that will give 'silicosis,' or the size of particle, or the number of particles, or the weight of the particles, or the percentage of silica in any dust to make it harmful, as well as numerous other data essential to a really correct determination of the definite cause of the injury to the health of the victim, even though the injury itself may be readily apparent."

THE RESOURCES OF CHINA

WHAT will happen next, now that China's Wild West is being tamed under the stress of the Sino-Japanese war?

Geographers are curiously watching the speed with which China's western and southwestern provinces, comprising one of the main areas still under the Chinese Government, are being invaded by schools, industries and millions of pioneers. The southwestern tableland of China, close to the Tibetan frontier, has been particularly isolated. About half of the eleven million people of this rugged tableland in Yunnan and Kweichow provinces are Chinese; the rest are people of about 200 different tribes so primitive and independent that the Chinese often refer to them as barbarians.

Even if great waves of immigrants should move back eastward when war emergencies are over, China's West and Southwest will never be the same, is the view of J. E. Spencer, set forth in the *Geographical Review*, of the American Geographical Society. Roads will remain, and some of the new industries and progressive developments are bound to last.

Whether industries developed as wartime projects will be profitable under peacetime conditions, Mr. Spencer can not foresee. But it will have been proved, he declares, that native iron from Szechwan province can be made into fine steel products, that airplanes can be manufactured in Yunnan's capital city Kunming, and that industrial chemicals can be produced in the West.

"As almost none of the Southwest's resources have been mortgaged or otherwise divided by concession among foreign interests," he points out, "they will constitute a valuable basis for native industrial growth."

Yunnan, the far southwest corner of China, he considers fated to be most affected by the swift changes, now that its remoteness and non-Chinese population are no longer barriers to the exploitation of its resources. In event of a prolonged war, it is foreseen that the seat of government may be moved to this extreme inland corner of China, to the capital of Yunnan.

ITEMS

ALL provisions of the national health program, presented at a conference called by the President last July and expected to become the basis of legislation at the present session of Congress, should be administered through the state health departments. This is the opinion of the American Public Health Association, as presented in a recommendation to the Technical Committee on Medical Care in Washington. Expansion of public health and maternal and child health services, of hospital, clinic and other institutional facilities, and provision of medical care for the medically needy, should have priority in initiation over other features of the national health program, the association recommends. Complete integration of all the Federal Government health services under one cabinet officer, preferably a Secretary of Health, is also recommended.

OFFICIALS of the U. S. Public Health Service are watching nation-wide health reports closely for signs of a coming influenza epidemic. So far, however, they see no sign of any and no cause for alarm. The total number of cases reported for the week ending December 24, the latest for which figures are available, was 1,634, excluding Pennsylvania, which has not yet reported for that week. An increase in this disease is expected at this time, it is pointed out. While in some regions of the country the number of cases has increased considerably over the 5-year average, it is not especially large in any region. Stay in bed and keep warm, if you have influenza, and call your family doctor, is the advice given by the Federal Health Service.

THE tug-of-war between order and disorder in nature is strongly exhibited by solutions, Dr. John G. Kirkwood, of Cornell University, told the symposium on intermolecular action of the American Chemical Society meeting in Providence, R. I. The forces between the molecules in a solution, he said, represent the forces of law and order which try to bring regularity out of random chaos. The forces of disorder, producing this chaos of randomness, are the helter-skelter wanderings of molecules due to heat. Two kinds of orderliness can exist in a solution containing two kinds of molecules. If the attractive forces between unlike molecules is greater than the attraction between like molecules, then each molecule builds up around itself a localized grouping of the opposite kind. Where attractive forces between like molecules are larger than between unlike molecules there is the opposite kind of grouping. Like molecules tend to group together and in extreme cases the solution will actually separate into two phases.

BEFORE children "break out" with measles, they may be given injections of convalescent measles serum that will spare them a severe attack and perhaps avoid a fatal or a prolonged illness. The use of convalescent serum in the treatment of measles after the appearance of the eruption has not proved successful in most cases, as stated by Drs. Jerome L. Kohn, Irving F. Klein and Herman Schwarz, of New York City, in the *Journal* of the American Medical Association. They report success in modifying the course of measles in 19 out of 24 children so treated at the Willard Parker Hospital for Contagious Diseases, New York. A doctor can diagnose a case of measles before the eruption appears by the presence of Koplik's spots. These are small bluish-white spots surrounded by a reddish areola which appear on the mucous membranes of the cheeks and lips during the early stage of measles.

THE U. S. Weather Bureau has re-christened the radiometeorograph, that featherweight little robot weather reporter that rides small balloons up into the stratosphere and wirelesses back the news about how cold it is, how damp it is, etc. The new name is "radiosonde," a word of French origin that has already been officially adopted in Germany. Objection to the name, meteorograph, was mainly to the "graph" part, which implies that the instrument makes a written record, which it does not do. "Sonde" is French for depth (or height) soundings: the rubber bubbles on which the radiosondes ride aloft are known technically as sounding balloons.

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SCIENCE NEWS

Science Service, Washington, D. C.

DISEASE RESISTANCE

A NEW theory of disease resistance and susceptibility has been developed through studies on rats conducted by Professor James T. Culbertson at Columbia University School of Medicine. The findings apply to man as well as rats, it is believed.

According to this theory, children and young people suffer more from some diseases than older people because certain cells in the bodies of young people have not grown up enough to act as protective agents against disease. Heretofore it has generally been believed that older people built up resistance through constant exposure. The particular cells that have to become mature before they can protect the body from disease are found throughout the body, but particularly in the liver, spleen and bone marrow. They belong to the reticulo-endothelial system.

The reticulo-endothelial system produces and mobilizes white cells in the blood which act as protective agents. Due to immaturity of this system, the changes in the number of white cells in the young rats following infection was very slight. Dr. Culbertson found that "On the other hand, the older groups showed a decided increase in white blood cells, particularly in monocytes. The maturity of the reticulo-endothelial system in the older rats enabled them to mobilize greater numbers of protective cells and therefore destroy more effectively the parasite causing the disease. While the monocyte response, or the increase in the protective cells in the blood, can not be considered to be the only cause of the older rats' resistance to the infection, in interpreting these findings it is difficult to escape the conclusion that it is a major factor. The following facts point directly to this: animals which showed an increase of monocytes survived while those which did not, died, the single, surviving member of the younger group was the only young animal that showed an increase in monocytes; the single animal in the older group that died was the only older one that did not show an increase."

Certain other cells of this system, the phagocytes, which like the monocytes are able to engulf or swallow foreign substances that might cause harm, were also more efficient in the older rats.

The third link between the ability of older rats to resist infection and the maturity of their reticulo-endothelial system is, according to Professor Culbertson's findings, the fact that the older rats were able to combat infection by mobilizing specific antibodies, another of the body's germ-fighting force, whereas the younger rats could not do this. He says: "In our experiments, the rats naturally acquired, as they matured, an increased resistance against both parasites used to induce disease, *Trypanosoma lewisi* and *Trypanosoma cruzi*, without being previously exposed to these agents. This definitely indicates that in many diseases the natural maturation of an animal, and not simply the building up of resistance because of constant contact, enables older animals to combat illness more effectively than young ones."

THE EFFECT ON BACTERIA OF ULTRA-VIOLET RADIATION

BACTERIA can be killed more effectively with ultra-violet radiation "bullets" by shooting them with pop-gun quantities of radiation than by pouring on the same amount of radiation with a heavy howitzer.

This principle, of possible great importance in the prevention, control and treatment of disease, is reported by two investigators of the Westinghouse Lamp Laboratories, Dr. Harvey C. Rentschler, director, and Dr. Rudolph Nagy.

Short, intense dosage of bacteria with the germ-killing rays found in a particular portion of the ultra-violet spectrum is less lethal than long, mild exposures, at least in the case of one species of germ, escherichia coli, a harmless variety used in their experiments.

The research tested the Bunsen-Roscoe reciprocity law, propounded more than seventy years ago. Applied particularly to photochemistry, this law suggests that the killing effect of radiation will be the same, whether the bacteria are subjected for a long time to low intensity radiation or for a short time to high intensity, provided the total energy is the same. They found that this is not true.

Their studies may be somewhat disappointing to those now developing ultra-violet radiation methods of germ control, because there is some mechanical advantage to the use of high intensities.

Drs. Rentschler and Nagy explain their results by supposing that there is a particular time in the life cycle of the bacteria when they are especially vulnerable. When short, intense exposure is used, not so many bacteria are caught at that particular time as in the case of the longer exposure. They found a minimum exposure below which there was no significant killing effect.

HIGH-SPEED PHOTOGRAPHY

A SPEEDING bullet that "shoots" itself is the newest addition to the ranks of the minifans—those camera enthusiasts who take pictures with the compact, miniature cameras.

At the Armour Institute of Technology, Chicago, a swift-flying bullet took its own picture. It used a new device to set off the trigger action that made possible an exposure time of only one millionth of a second.

Drs. F. W. Godwin and A. O. Walker demonstrated their new system of bullet self-portraiture which utilizes the light from a long thin tube that glows into luminescence when 38,000 volts of electricity break down across it. This discharge tube is under partial vacuum. Connected to its electrical circuit is a spark gap. As the bullet speeds to its target—in the demonstration case a sheet of plate glass—it passes between the two poles of the spark gap. The imminent discharge in the tube is just at the unstable condition of being ready to discharge but not being quite able to do so. As the bullet passes through the spark gap some of the gases of its firing follow along behind it, like the tail of a comet. These gases change the electrical condition of the spark gap, make it dis-

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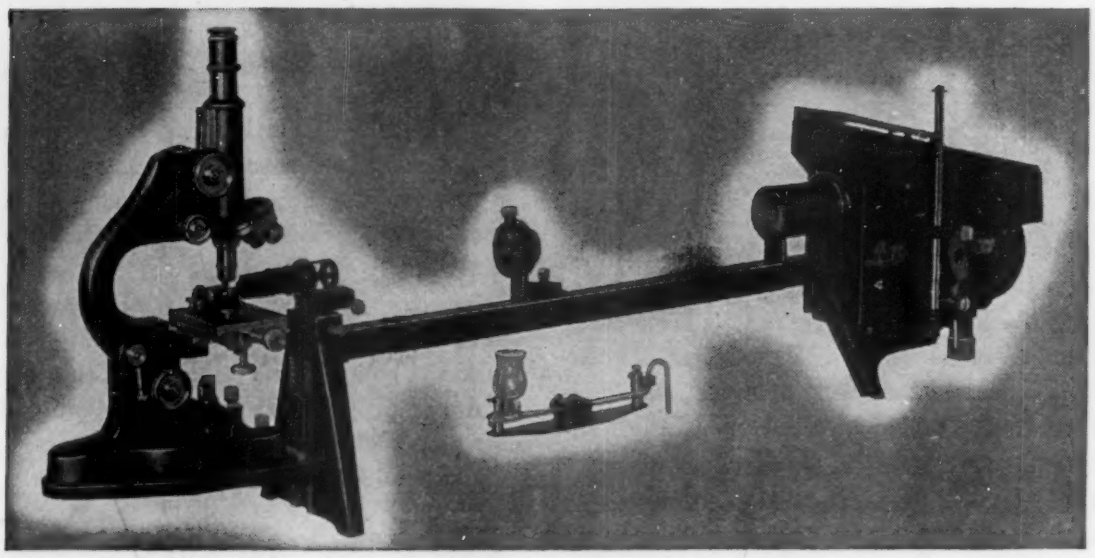

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charge and thus produce an intense light which makes possible the photographing of the moving bullet with a small, miniature camera.

The new method is said to be the first case where such high speed photography is accomplished without the use of an independent mechanism causing the tripping of a shutter or the discharge of a spark for illumination. The pictures taken show: a bullet in flight just before it strikes a plate of glass; just as the bullet is half way through the glass, showing cracks beginning to form in the glass, and finally after the bullet has passed through the glass, but with the shattered glass still standing in place.

Records of bullets and shells in flight have previously been obtained by other methods. The usual method is to shoot the bullet through some trigger mechanism that will suddenly cause a light to flash or a spark gap to discharge. The passage of the steel bullet through a magnetic field has been found to create enough disturbance to trip off an auxiliary mechanism and record the flying bullet.

In other cases the bullet is made to break a wire or network of wires and do the same thing. Experiments in Canada have tested the velocity of artillery shells by passing them through reflected beams of light that form what amount to invisible "curtains." As the shell momentarily cuts off the light beam from a photocell, the electrical impulse produced records the position of the shell at intervals. From these data the velocity can be computed.

The difference between these past methods and the new Armour Institute technique is that in the latter the passage of the bullet through the space between the pole pieces of the spark discharge is itself the act which trips off the illumination source. All other methods are said to involve the use of auxiliary apparatus.

THE NEW ENGLAND HURRICANE

THE freak New England hurricane of last September was a tragic thing from the standpoint of loss of life and property damage, but its lessons are teaching beach erosion experts of the Federal and State Governments how to provide better protection and preservation for the future.

Only now, at the meetings of the American Shore and Beach Preservation Association, are the authentic hurricane facts being presented. Major A. C. Lieber, Corps of Engineers, of the Beach Erosion Board, Washington, D. C., described the little-noted point that at places where the greatest damage to property occurred, there was often little damage to the beaches. In some cases beaches in these locations were better after the hurricane than before. The reason, he explained, was that the great increase in tides in some localities permitted the heavy seas to break inland from the beaches. Thus while the seas destroyed much property the beaches themselves were spared.

Rear Admiral L. O. Colbert, director of the U. S. Coast and Geodetic Survey, reports that while a systematic check of high-water marks over the whole New England area has not been completed the figures at some of the most important tide stations are now available.

At the edges of the hurricane region, New York on the south and Boston harbor on the north, the hurricane tides were from two to four feet above mean high water. At the intermediate tide stations, however, the rise was much greater above mean high water: 8.6 feet at New London, 10.4 feet at Newport, 8 feet at Woods Hole, Mass., and the peak, 13 feet, at Providence, R. I.

Along Long Island, sand dunes which had taken 100 years to build up by slow accretion from the sea were washed away in a few hours. Private sea-walls, protecting shorelines of estates, were found—in many places—to have caused major damage to neighboring regions. These sea-walls in many cases failed ultimately to provide protection of the estates they were supposed to guard because the excessively high water and mountainous waves flowed over them.—ROBERT D. POTTER.

PILOT'S LICENSE FOR "FOOLPROOF" PLANES

THE Civil Aeronautics Authority will issue a new grade of pilot's license requiring less training than at present as soon as the aviation industry has developed "foolproof" airplanes for sale to the man in the street, it has been learned.

The day when an airplane that will not spin, can't stall and won't nose over on landing is actually on the market is believed not far off. At that time, simplification of flying procedure will make learning how to fly much easier and will require less time.

Pilots holding these special licenses would be permitted to fly only the "foolproof" planes. To fly other types regular licenses, from private grade up, would still be required. The step of creating this new pilot grade would be of inestimable importance to the development of flying as a mass sport, aviation leaders believe.

Though Grove Webster, chief of the private flying development division, said no such step is contemplated at present and denied that discussion of it had taken place, it was learned that some CAA people and private industry men have tentatively talked it over. At least a year must elapse before the plan can be considered for putting into immediate practice.

One model that represents a stride in the direction of the "foolproof" plane and may actually be it is now undergoing tests for its CAA approved type certificate near Washington. It features the tricycle landing gear and can not nose over because of its nosewheel. Landing planes equipped with the gear is much simpler than landing the conventionally fitted ship. It is reported to incorporate also other late safety developments.

Air leaders, however, are still going slow when it comes to talking about "foolproof" planes. Though engineers feel it possible to develop a small plane which the adjective "foolproof" might fit, none has actually so far been placed on the market. Past "foolproof" planes haven't been "foolproof" against flying fools. Even the safer types now being developed will still require a maximum of common sense even though only a minimum of skill may be needed.—LEONARD H. ENGEL.

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A FIGHT to the bitter end in the case arising from the District of Columbia grand jury indictment of the Amer-

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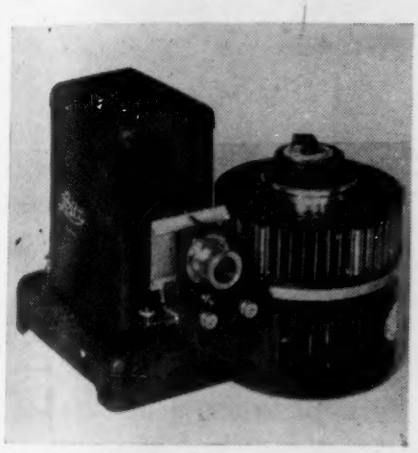

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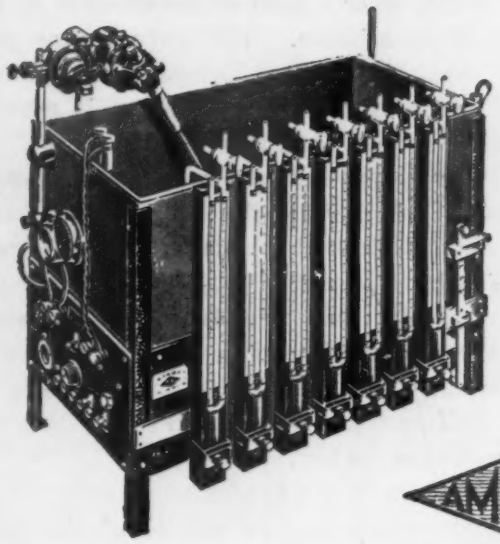

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ican Medical Association is forecast by denial by the medical association of reports that it had made overtures to the Department of Justice for an out-of-court agreement.

The American Medical Association has not attempted to settle the anti-trust law violation charges, according to an editorial in this week's issue of the *Journal* of the American Medical Association. The *Journal* has previously stated "that the House of Delegates has already authorized the Board of Trustees to fight this case to the courts of last resort to determine the issue."

Under the title, "Commentators Spread False News," Dr. Morris Fishbein in an editorial contradicts the statement made by the Washington columnists, Drew Pearson and Robert S. Allen, in the "Washington Merry-Go-Round" on January 8, that officials of the American Medical Association had made such overtures. They said that the negotiations were getting nowhere "because of the physicians' insistence that the medical society be given special privileges under the law."

"As far as is known in the headquarters office of the American Medical Association, no official of this association has made overtures to the Justice Department to compromise the case," the *Journal* states. "Neither have attorneys for the association, nor has any official been authorized to make overtures or to conduct such negotiations."

"A telegram was sent to Messrs. Pearson and Allen calling attention to the misstatements of fact. No answer was received. Mr. Allen was then called on the telephone. He said: 'We received our information from the Department of Justice from a source we consider unimpeachable.'"

ITEMS

EXPENDITURES of $180,000,000 were made in 1938 for industrial and engineering research, according to estimates published in *Industrial and Engineering Chemistry*. The estimates were made from figures compiled by Dr. William A. Hamor, of the Mellon Institute, Pittsburgh.

INFLUENZA cases reported throughout the nation increased to 3,225 during the week ending January 7, according to the U. S. Public Health Service. The rise is not, however, considered significant. An increase such as this is expected at this time of the year and does not necessarily mean an epidemic. Federal health officials are playing the rôle of watchful waiters over the situation. Largest number of cases were reported from the South, South Carolina having 909 and Virginia 454.

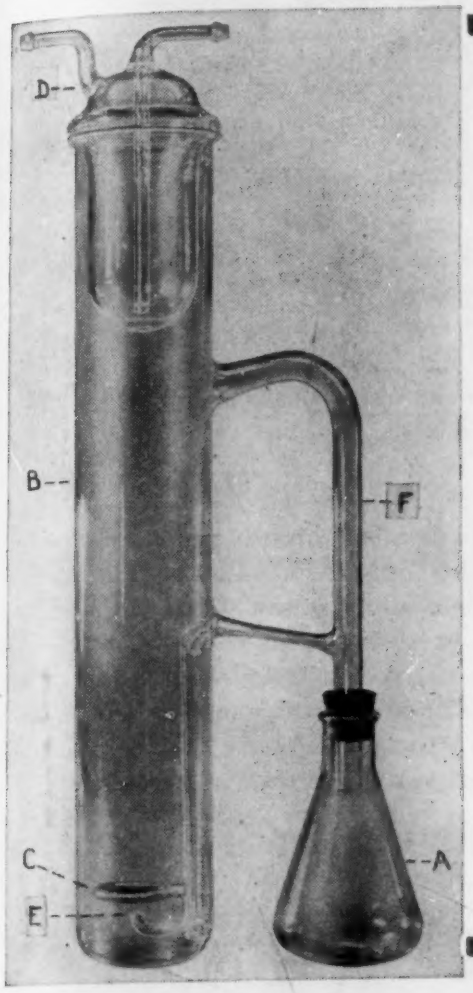
COMPLETE records for 1938, now compiled in the office of the U. S. Weather Bureau, show that the year was warm and wet. Although the extreme high summer temperatures of the drought years were not reached, the averages, including those of the mild winter months, made it one of the warmest years of record. One unique feature, to which the Weather Bureau calls attention, was that every first-order station in the country reported above-normal temperature for the year, probably an unprecedented condition. For the country as a whole, the average precipitation of 29.47 inches was about 1 per cent. above normal. This is slightly less than last year's record of 30.34 inches.

THE Arctic ice is thawing out, and has been for at least twenty years, declared Professor L. Berg, of the University of Leningrad, in a report to Tass. Some of the indications, derived from observations by himself and other Soviet scientists and explorers, are: Recession of ice boundary; appearance of warm-water fish and other marine animals in Arctic regions; higher temperatures observed in sea water; boats passing the hitherto impassable northern limits of Franz Josef Land and other Arctic islands; earlier thawing and later freezing of Arctic rivers; northward retreat of the limits of permanently frozen soil in Siberia.

DEFINITE proof that a school of whale sharks exists in the waters around the Bahama Islands has been reported to *Nature* by Dr. E. W. Gudger, of the American Museum of Natural History. Observations on a school of a dozen of the enormous fish, ranging in length from 18 to 31 feet, were made by a Camden, N. J., citizen, E. R. Fenimore Johnson, while cruising in his ketch. He was also able to get about 200 feet of motion picture film, showing the sharks feeding. It is the first known observation on the feeding habits of this species. The whale shark behaves surprisingly like some whales who are his namesakes. He cruises along, barely submerged, with his huge mouth partly open. In this moving trap he catches whatever small animal forms happen to be afloat, filters the water out through his gills, and swallows his small prey in quantities.

GOLD production in the United States in 1938 increased six per cent. over 1937, according to preliminary estimates furnished by the U. S. Bureau of Mines. The increase is in units of weight rather than in dollar value. Since 1933 the production of gold in the United States has nearly doubled in weight, amounting to an increase of 94 per cent. Of the 1938 production, California contributed 25 per cent.; Philippine Islands, 17 per cent.; Alaska, 13 per cent.; South Dakota, 12 per cent.; Colorado, 7 per cent.; Arizona, 6 per cent.; Nevada, 6 per cent.; Utah, 4 per cent., and Montana, 4 per cent.

THE menace of the one-eyed driver, of whom there are in effect from 20 to 40 out of every 100 persons behind the wheel of an automobile, is made even worse by the fact that most of these drivers are ignorant of the dangers due to their deficient vision. Drivers completely blind in one eye make up only one or two per cent. of all drivers, according to a report made by Drs. H. R. De Silva, W. H. Frisbee, Jr., and P. Robinson, of Yale University, to the National Society for the Prevention of Blindness. But from 20 to 40 per cent. of all motorists have deficient vision in one eye which handicaps them enough to make them dangerous on the road. "The greatest human hazard," the investigators state, "arises not from the defects but from ignorance of the dangers from such defects. For most of these drivers the solution lies in personal re-education adapted to their individual needs. For others, and especially those who have shown themselves incapable of profiting from re-education, the solution lies in revocation of their licenses."



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*"A Rapid and Simplified Method of Extracting Urinary Estrogen" by S. L. Leiboff, M.A., and Abraham B. Tamis, M.D., in the Nov. 1938 issue of the "Journal of Laboratory and Clinical Medicine," pp. 178–180.

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SCIENCE NEWS

Science Service, Washington, D. C.

THE LIMITS OF THE UNIVERSE AND THE CURVATURE OF SPACE

PROFESSOR HOWARD P. ROBERTSON, mathematical physicist of Princeton University, in the opening address of the 1939 Sigma Xi lecture series, which was given at Louisiana State University on January 20, stated that astronomy has reached a temporary impasse in its attempts to figure out the curvature of space and the limits of the universe.

On the basis of present observation, relativity theory of the universe has led to a model of space which has so large a curvature that its limits—if you think of it as some huge ball—are much too confined. By Einstein's relativity theory curvature of space is linked with the density of matter within that space. To bring about the curvature indicated by present knowledge matter would have to have more than sixty times the density now observed by telescopes. Moreover, if the universe is thought of as expanding, the most distant nebulae would have to have been close together at some time, about 1,000 million years ago. This vast time is much too short, however, for rocks are known on earth which are probably twice as old as this. And the final dilemma of astronomy is that if the limits of the universe correspond to a sphere with radius of 500 million light years then astronomers are now looking through their present telescopes and seeing nearly to the ends of space.

With the 100-inch Mount Wilson telescope, Dr. Edwin Hubble has detected distant nebulae which are about 500 million light years away. A light year corresponds to about six million million miles. Few people seriously believe that astronomers are now looking to the end of space and believe that the new Mount Palomar 200-inch telescope, when it goes into operation, will open new vistas for astronomy. Yet if space has limits now predicted by theories this would not be so.

HIGH-FLYING AERIAL SURVEY PLANES

HIGH-flying special aerial survey airplanes—cruising at 30,000 feet—will end the day of man's ignorance of the earth on which he lives, Talbert Abrams, president of the Abrams Aerial Survey Corporation, told the meeting of the American Society of Photogrammetry meeting in Washington.

Less than five per cent. of the earth's surface is accurately mapped because of the high cost of ground surveying and the inaccessibility of some regions. By aerial photography, from substratosphere altitudes, it should be possible to get accurate aerial maps for less than $1 a square mile. The economic value of accurate maps, Mr. Abrams contended, would make feasible the cost of developing planes that would fly higher even than the substratosphere planes now under construction for the airlines of America, which are designed for operation at a service ceiling of 20,000 feet.

"Considering the economics of high altitude mapping with a wide-angle lens against the cost of mapping at lower altitudes with multiple lens cameras," according to Mr. Abrams, "the advantage is in favor of high altitude airplanes especially equipped for the job. It is my belief that airplanes for high altitude work can be built at a price approximately equal to the price of multiple lens cameras. This being the case, more work could be done in the air and less work would have to be done in the laboratory in transforming photographs made with a multiple lens camera."

Aerial photography at altitudes of 30,000 or even 40,000 feet would be especially valuable over the mountainous regions of the West, where much of the land has low value and it is far too costly to obtain low-altitude maps showing only small sections of the land in each aerial view. With radio-controlled planes of the future it should also be possible to have robot cameras in planes which would fly over the enemy lines and take aerial photographs, recalling suggestions of the Army. It might even be possible, he added, to have aerial cameras project their views on a ground glass screen, televise this image, transmit it back to a television receiver and photograph the televised image. In this way aerial maps in wartime could quickly be obtained.—ROBERT D. POTTER.

THE STEREOPHONIC RECORDING SYSTEM OF THE BELL TELEPHONE LABORATORIES

A STEREOPHONIC recording system, one of the triumphs of communication engineering, will provide New York fair visitors with an "amateur hour" which, John Mills, director of the Bell Telephone Laboratories publications, promises, will amuse the crowds.

The Voder, the machine that talks like a man and in which speech is created entirely artificially by an operator punching a keyboard, will "lecture" at the exhibits of both New York and San Francisco.

Visitors to the Bell System Exhibit Building at the New York show will come upon a long room at one end of which is a formal garden set about 25 feet deep and extending from sidewall to sidewall. The garden slopes up to a terrace on which are seated six persons carrying on a conversation. The spectator will quickly recognize that five are members of the audience and the sixth is an exhibit employee. All they say will be heard plainly through concealed loudspeakers. After a couple of minutes of friendly visiting, the six people will get up and walk the length of the room to rejoin the audience. As they do so, the set moves slowly sidewise and is replaced by a duplicate set. But, instead of people, the chairs are occupied by mannequins.

As they reach the audience, all that the six have said is repeated. Because of the stereophonic recording, which locates the sound in three dimensions in analogous fashion to stereoscopic pictures which give depth to photographs, the words seem to come from the mannequin seated where the person who originally spoke the words was.

The audience will enjoy it, the Bell exhibitors think, in their summaries of the exhibits in the forthcoming issue of *The Bell Telephone Quarterly*, in which Thomas W. Williams describes the New York show and L. N. Roberts the one at San Francisco.

The two exhibits will include the expected demonstration long distance telephone call, as at previous expositions. But this time the calls will not be limited to a selected group of cities. You can call any 'phone in the country—if you are one of the lucky persons chosen by the chance devices set up to make a selection and if you don't mind having a hundred people hanging on the "party line."

The telephone has made a spectacular subject for expositions from the earliest days. The telephone itself, which seemed unbelievable to the skeptics of 60 years ago, was the sensation of the Centennial Exposition in Philadelphia in 1876, the first of the big time expositions in the United States. And at Chicago was exhibited the speech scrambler designed to make transoceanic radiotelephone conversations unintelligible to any who might wish to eavesdrop.

X-RAY TREATMENTS AND GLAND DISEASE

ENCOURAGING results with x-ray treatments of a painful and usually fatal gland disease and a new theory of the cause of the condition are reported by Dr. Evelyn Anderson, Dr. Webb Haymaker and Michael Joseph, of the Institute of Experimental Biology of the University of California.

The condition is known as Cushing's disease. The patients get very fat around the neck, shoulders, face and trunk, become round-shouldered and are troubled with backache and abdominal pain. High blood pressure, diabetic symptoms and diminution of sexual activity are other characteristics of the disease. The patients live about five years on the average.

Now it is suggested that the primary cause of the disease is overproduction of the cortical hormone by the adrenal glands. These are the small glands that are perched like cocked-hats just above the kidneys and that produce life-saving adrenalin and life-essential cortin. An excess amount of this hormone substance has been found in the blood of suspected patients.

Tumor of the pituitary, the small but important gland in the head, has been considered the cause of the condition since the first cases were reported in 1932 by Dr. Harvey Cushing, of Yale University. Other glands were believed to be secondarily involved. X-raying the adrenal glands in a selected group of patients has given encouraging results in the way of reducing the excess weight, modifying the diabetic condition and decreasing the excess of red blood cells.

ULTRA-VIOLET RADIATION FOOD PRESERVATIVE

LONGER storage of meat and other food without spoiling or changes of color is made possible by use of ultra-violet radiation combined with other more usual food preservation practices, Professor Arthur W. Ewell, of the Worcester Polytechnic Institute, told the American Society of Refrigerating Engineers at a recent meeting.

The germ-killing effect of the radiation, now being set to work for bactericidal purposes in a dozen different fields ranging from sterilizing the air in hospital operating rooms to the packing industry, can be attributed to its power of forming ozone from the oxygen in the air.

Proper "housekeeping" methods are necessary to take full advantage of the ultra-violet installation, however. It isn't a cure-all and does not take the place of ordinary sanitary measures. While it will halt the growth of decay germs introduced into a food storage room in which ultra-violet lamps are placed and will prevent their spread, it will not do so if filthy foods are continually introduced.

No marked alteration of the appearance of the food or of its taste is produced unless the radiation used is so intense as to cause burning or the food is placed too near the lamp.

Foods not directly under the light of the lamps can receive the benefit of the ozone if a gentle air current passing the lamps is directed to them, the Massachusetts food preservation expert declared.

Use of ultra-violet light has several other important advantages. First is that it permits the storage of food in extremely humid atmospheres, which cuts loss of the food's moisture by evaporation markedly. Second, a slight coagulation of meat surfaces, which reduces shrinkage, takes place. Ultra-violet radiation also shows undesirable changes of color, particularly if this treatment is combined with low temperature storage.

The taste and color of very few foods other than meat is affected by excessive radiation. Butter and cream may acquire an "off" taste and the butter may be bleached slightly if it is too near the lamp, and some fruits may undergo color changes, but these ill-effects may be eliminated by placing the foods in question out of the direct radiation.

ITEMS

THE year's first comet, so bright that it can be seen through opera or field glasses, has been discovered low in the northwest sky by Leslie C. Peltier, an amateur astronomer, of Delphos, Ohio. In an interview with Science Service he stated that the new stellar object is of the eighth magnitude of brightness, just too faint to be seen with the naked eye. It is easily visible in the six-inch refracting telescope of Princeton University which Mr. Peltier has been using, on loan, for the last 15 years. Near the constellation of Pegasus, the new comet's location is right ascension 21 hours and 20 minutes and its declination 28 degrees north. Whether the comet has a tail or is in rapid motion was yet undetermined on January 19.

WHAT is believed to be the fluffiest snow on scientific record is reported by Professor C. F. Brooks, of Harvard University. It fell at Milton, Mass., where Harvard's meteorological station, the Blue Hill Observatory, is located. There was only half an inch of it, and it took three hours for it to accumulate, for the flakes fell very slowly—less than two feet per second. Professor Brooks blocked out a square yard of it, as it lay on the hard crust of an earlier snow. He packed it into snowballs and weighed it. He found that the water equivalent was only 1/63; that is, it would have required 63 inches of this snow to make one inch of water. Ordinary snow has a water equivalent averaging 1/10, and the fluffiest snows commonly observed range from 1/20 to 1/30.

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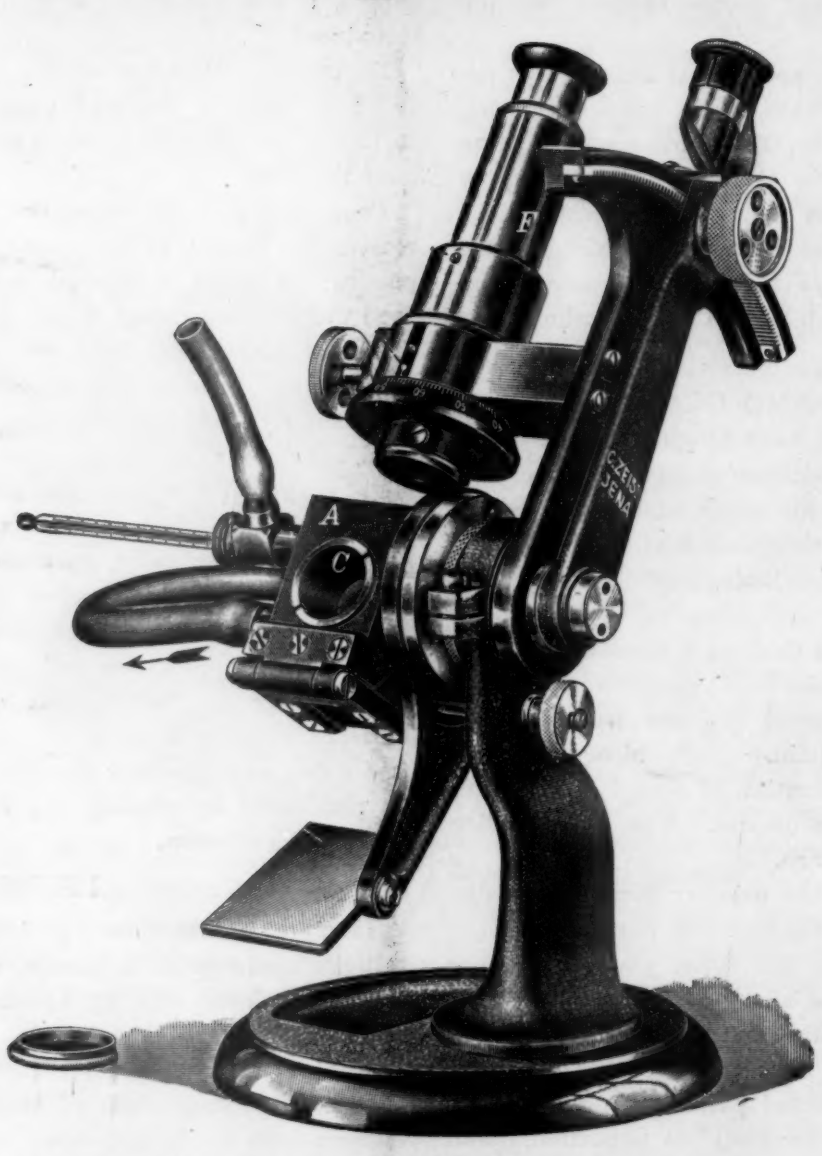

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SCIENCE NEWS

Science Service, Washington, D. C.

SOME PAPERS READ AT THE RICHMOND MEETING OF THE AMERICAN ASSOCIATION AND ASSOCIATED SOCIETIES

FAITH is as important in the pursuit of scientific knowledge as intuition and reason, while "to-day the significance of science as a principal source of revelation is almost universally recognized." This was the essence of the address of the retiring president of the American Association for the Advancement of Science, Dean George D. Birkhoff, of Harvard University. The address was printed in full in the issue of SCIENCE for December 30. Dr. Birkhoff made a plea for an essentially religious attitude toward the problems of science and society, suggesting the following as articles of scientific faith: (1) It is desirable to accord reality in equal measure to all kinds of knowledge everywhere, and so to view the universe as broadly and impartially as possible. (2) In order to understand the various facts and their interrelations we must always use abstractions that is, conceptual tools of a logical or mathematical nature. (3) The transcendent importance of love and good-will in all human relations is shown by their mighty beneficent affect upon the individual and society. He pointed out that any one is free to agree or disagree with these articles of faith because they are not verifiable experimentally or strictly demonstrable.

THE address of Sir Richard Gregory, for many years editor of *Nature*, urged the duty of scientific men "to assist in the establishment of a national and harmonious social order out of the welter of human conflict into which the world has been thrown through the release of uncontrolled sources of industrial production and lethal weapons." He stated that "men of science are citizens as well as scientific workers and are beginning to realize their special responsibilities for securing that the fruits of scientific knowledge are used for human welfare. They can no longer remain indifferent to the social consequences of discovery and invention, or be silent while they are blamed for increasing powers of production of food supplies, providing means of superseding manual labor by machines, and discovering substance which can be used for destructive purposes. It would be a betrayal of the scientific movement if scientific workers failed to play an active part in solving the social problems which their contributions to natural knowledge have created. The view that the sole function of science is the discovery and study of natural facts and principles without regard to the social implications of the knowledge gained, can no longer be maintained. It is being widely realized that science can not be divorced from ethics or rightly absolve itself from the human responsibilities in the application of its discoveries to destructive purposes in war or economic disturbances in times of peace. Men of science can no longer stand aside from the social and political questions involved in the structure which has been built up from the materials provided by them.

AT the annual science exhibition practical applications to present human needs stood side by side with displays of "pure" research whose applications have yet to be found. Here, for example, was a robot "radium hound" devised by physicists at the National Bureau of Standards in Washington, D. C., which can "sniff" a millionth of a gram at the distance of a yard. It kicks over the needle on a millimeter whenever there is a trace of radioactive material in the neighborhood. Among other things, it can be used to locate "seeds" of radium that sometimes get lost in hospitals. There was an exhibit of work that Bureau of Standards engineers have been doing in brick and mortar, steel and concrete. A metal tube that sings was part of a display presided over by Professor Charles T. Knipp, of the University of Illinois. When the tip is warmer than the rest of the tube, it gives off a musical tone. The exhibit of the Boyce Thompson Institute for Plant Research, Yonkers, N. Y., showed how the tomato plant indicates by its growth responses the nature and strength of various chemicals that influence the life of plants.

A SMOKING machine was shown in the booth of one of the leading commercial tobacco companies which tested smoking qualities of endless samples of tobacco, from lots destined for use in cigars, cigarettes and pipe mixtures. A display sponsored by Duke University demonstrated the new method for keeping at bay the deadliest fungus enemy of tobacco seedlings, blue mold, through fumigation with benzol vapor.

THERE was a voting booth in the exhibit hall. The question at issue was mannose, which tastes sweet to some persons, bitter to others, and to still others has no taste at all. Some perceive it as bitter at first and then sweet, others taste the sweet and then the bitter. It is in an endeavor to get a large statistical sample of the mannose tastes of the populace that Dr. A. F. Blakeslee, of the Carnegie Institution of Washington, set up his polling booth. To all comers he gave a sample of mannose to taste. Then they registered their reactions in the booth. Drs. Oscar Riddle and Robert W. Bates, of the Carnegie Institution had an exhibit demonstrating the extraordinary effects of prolactin, a ductless gland secretion or hormone produced by one part of the pituitary gland that lies within the skull, just below the brain. This small gland, which has been called the "master gland" of the body, shares with the brain the distinction of most widespread control over the activities of organs quite distant from itself, and over the conduct and personality of the individuality as a whole.

THE technique of using electron beams to disclose tiny details in nature, far beyind the limits of any microscopes using light in the usual way, is rapidly being perfected, according to the report of Dr. V. K. Zworykin, of the Radio Corporation of America. "It can be shown that, even taking account of certain fundamental defects of

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electron lenses, electron microscopes are essentially capable of resolving separations of the order 0.000001 millimeters.'' This resolution, amounting to a millionth of a millimeter, reaches down into the size of the super giant molecules which have been shown to be present in some of the filterable viruses, particularly the virus causing tobacco mosaic disease. Some of these molecules have weights 25,000,000 times greater than ordinary molecules of common chemical elements. The essential point about these huge chemical molecules of the viruses is that they are believed to represent the borderline between animate and inanimate matter. Although the viruses, at least some of them, have been shown to be chemical in nature they have been found to be capable of reproduction and possess biological activity which has always been associated only with living things. German scientists using electron microscopes are now studying colloidal suspensions and have reported the separation of detail spaced only one hundred thousandth of a millimeter apart (0.00001). The use of electron microscopes in the study of extremely minute particles has so far found its best use in studying the surfaces of glowing metal filaments of electric lights and in analyzing crystal structure in thin films of metals. Much more difficult is the study of biological specimens. The swift-flying electrons used in electron microscopes can not only kill biological specimens but can actually destroy them.

DR. THOMAS M. RIVERS, of the Rockefeller Institute for Medical Research, believes that the viruses that cause disease, and which are much too small to be seen, are a very ''mixed lot,'' having only their size and disease-causing ability in common. ''Some of the viruses,'' he said, ''may be minute, highly parasitic microorganisms, the midgets of the microbial world, capable of reproduction only within susceptible host cells, others may represent forms of life more or less unfamiliar to us, and still others may be fabrications of their host cells aided by the processes of autocatalysis. What life is and where the transition from the non-living to the living takes place, if it does, in the scheme just set forth is not known. Furthermore, the transition may be so gradual that it will be difficult for investigators to assign the particular point at which it occurs.'' Yet despite the handicaps which their minute size and often puzzling behavior imposes on research, Dr. Rivers stated that a good deal has already been found out about them. We have a pretty good idea of the sizes of some of them; they range from almost the size of some of the smaller bacteria down to that of single protein molecules. We can also infer that at least three shapes are found among them: round, oval and rod-like. We know that they commonly have the same kind of electrical charges found on protein molecules. With his co-workers, Dr. Rivers has made a special study of the vaccine virus, which is the virus of cowpox used in vaccinating against smallpox. They worked out a new method of producing it in quantities large enough to handle by laboratory methods, and thus got a good supply to study. Among other studies was a direct chemical analysis of purified elementary bodies of this virus, that is, of the tiny units that actually produce the biological results of vaccination. The dried elementary bodies were found to contain 83.12 per cent. protein, 8.54 per cent. fat, 0.72 per cent. ash, 5.56 per cent. residual moisture, 2.06 unidentified material, including a trace of carbohydrate. ''These analyses,'' Dr. Rivers stated, ''do not differ materially from those recorded for bacteria or for protoplasm.''

EVOLUTION of man and all lesser living things gains scope and takes on new grandeur by being traced far below the world of life to the very chemical elements themselves. A new visualization presented by Professor George A. Baitsell, of Yale University, bridges the gap between the living and the non-living with recent new knowledge of gigantic chemical molecules of viruses that act as though they were alive. The difference between the living and the non-living is shown to be a matter of complexity. The same materials are used in both domains and they conform to the same elemental patterns. The natural world is fused so effectively that the procession of organic development flows uninterruptedly from atom to man. There is no need to worry as to just when and at exactly what stage life was infused into the evolving stuff of the natural world. In that ultra-Lilliputian border land where the most powerful microscopes lose their sight, increasing complexity evolves into what has been labeled ''life.'' From the simplest substance in the organic world to the most complex patterns of living substance there must be a graded series. Should evolution begin at the level of the living organism? The union of hydrogen and oxygen to form water, the union of carbon and oxygen to form carbon dioxide, the union of water and carbon dioxide to form sugar, the addition of other elements to the sugar molecule to form protein—were not all these stages in the evolutionary processes which have led to ever-increasing complexity, reaching their climax in the world of life?''

THE mental disease bill for the United States during one year, 1937, was $935,723,308. This is an estimate of the total cost of mental disease based on loss of earnings and cost of maintenance of mental disease patients both in institutions and in their own homes. It was presented in the symposium on mental hygiene by Dr. Horatio M. Pollock, of the New York State Department of Mental Hygiene. The economic loss due to hospital cases of mental disease in the United States during one year Dr. Pollock figures at $803,176,308. The number of mentally sick persons outside hospitals and the extent of their disability is not exactly known, but from figures of the national health survey conducted by the U. S. Public Health Service, Dr. Pollock estimates the number of mentally sick over 14 years of age to be 266,618. The total economic loss on account of mental disease outside of institutions in 1937, figured at $1,500 a year for males and $1,000 a year for females, amounts to $132,547,000.

A CONCERTED attack on mental disease in the laboratory to supplement that going on at the bedside was urged at the symposium by Dr. Charles P. Fitzpatrick, clinical director at Butler Hospital, Providence, R. I. The whole-hearted and intelligent cooperation of workers

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in biology, physiology, sociology, psychology and many other sciences must be enlisted to aid psychiatrists in solving the tremendous problem of why human beings act as they do. Central research institutes for every state hospital system are the key to the plan proposed by Dr. Fitzpatrick as the answer to America's mental health problem. Public authorities should devote from one half to one per cent. of their appropriations for mental hospitals to research. The central institute should be able to call on any hospital for research material. And individual hospitals should send men to the research institute for training in experimental attitudes and techniques. Careful cooperation between clinical staffs dealing with the patients themselves and the laboratory men at work on research problems is urged. Small state hospital systems should get together to form a group and set up a research center to serve all those states. Or they should be permitted to make use of the research center of a neighboring state. A central clearing house should serve to keep all workers in the nation informed of the work being done in their own fields and also in other allied fields. This central clearing house should have adequate library facilities and should provide bibliographies to all workers with definite projects in mind. This central unit should coordinate the research of the whole nation so that the whole army of research workers would be pulling together in perfect harmony and without duplication to solve this national problem. It could also serve to allocate funds available for research so that the whole program will be advanced in the best way. The matter of training of research personnel is an important one that would be served by such centralized research units.

PHYSICIANS and medical scientists generally would do well to investigate more thoroughly the problem of fatigue, what it does to mind and body and its possible rôle in causing mental disease, according to the report of Dr. John W. Thompson, of the Harvard University Fatigue Laboratory. A hint of a real link between the kind of fatigue that comes after muscular exertion and the kind of fatigue associated with mental disease has been obtained in as yet unpublished studies at the Fatigue Laboratory. In an unusual percentage of mentally sick patients suffering from schizophrenia certain changes in blood constituents during rest were found which are similar to blood changes resulting from exhaustive muscular exertion. Another possible indication that fatigue may have something to do with mental disease appears in the fact that a spinal reflex can be fatigued by repeated stimulation. Perhaps other reflexes can be affected by fatigue in a similar manner. Reflex activity is so related to behavior that it seems reasonable to suppose fatigue of reflexes might cause a change in behavior which would appear as mental or nervous disorder. Dr. Thompson pointed out that much more investigation is needed to show whether there is anything in the idea. But investigation into the mechanisms that result in pathologic fatigue might produce knowledge which could be used to eradicate this sort of fatigue.

THE task of providing for the mental health needs of the people is enormous and complex, but American enterprise and organizing talent may prove equal to the task. This optimistic note was sounded by Dr. C. Macfie Campbell, director of the Boston Psychopathic Hospital and professor of psychiatry at Harvard University Medical School, in summing up the deliberations of leaders in the field during a three-day session on mental health. "Mental hygiene is a broad field as it deals not with simple, well defined diseases but with the personal equilibrium and the social adaptation of the individual," Dr. Campbell said. "It is as broad as human nature. There are certain outstanding needs that cry for relief." He pointed out that the care of the 500,000 patients in the mental hospitals of the United States is very unequal. He referred in this connection to inadequate appropriations and interference of "predatory politicians." A review of this whole situation is a "primary need." It is more than an economic question, Dr. Campbell said. The community needs education as to what mental disorders mean. "They are not diseases in the ordinary sense of the word. They are the failures of individuals with their special needs to get satisfaction out of life in their actual environment. One therefore has to consider the fundamental needs of human nature and the resources of society for satisfying these needs. Alcoholism and delinquency may represent poor outlets for unsatisfied needs. Mental disorder has the same significance. We learn much about human nature from the study of mental patients for they discard conventions and culture and reveal basic human nature. Mental hygiene is a medico-social problem. Much research is required. Funds are inadequate and disproportionate to the magnitude and complexity of the task. The task involves the cooperation of scientists working in different fields: the physician, the physiologist, the psychologist, the sociologist, the economist, the cultural anthropologist."

WEATHER forecasters tried their hand at another kind of prophecy, telling how they will do their work in future years, in a paper presented by W. C. Devereaux, senior meteorologist of the office of the U. S. Weather Bureau in Cincinnati. This paper, Mr. Devereaux explained, was not written by himself alone, but represented the opinions of a large number of Weather Bureau scientists, sent at the request of the late Dr. Willis R. Gregg, until recently chief of the bureau. Fifty years from now television instruments will enable a man to stand at one spot and look at the skies of a thousand different places all over the earth. He will also be able to read the records of robot instruments on mountain-tops and carried aloft by airplanes, balloons, possibly even rockets, all automatically broadcast for any interested observer to pick out of the air as he chooses. The weather map of the future will not be the flat, two-dimensional affair of yesterday and to-day. It will rise into the third dimension, telling conditions high aloft as well as on the ground. It will indicate conditions to come not for a mere day or two but for several weeks in advance. And it will be distributed so rapidly that a farmer in the field or an engineer far off in the lonely mountains can keep himself constantly posted on the whole world's weather. Weather study will no longer

HOLT'S feature Books for 1939

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By **Paul Weiss,** University of Chicago

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be a practical monopoly of the Weather Bureau. This will still be the central agency, but every university and college will have its faculty meteorologist, and all important business firms will maintain cooperating weather services.

DR. CHARLES S. PIGGOT, of the Geophysical Laboratory of the Carnegie Institution, presented a report of the preliminary findings of his exploration of the depths of the ocean with his deep-sea sounding device. It provides a way to study the past of the earth. In the deeper parts of the ocean the record of the earth's history is preserved in layers of sediment, deposited in orderly sequence, century after century, recording what happened both on land and in the sea. Two miles and more beneath the ocean's surface a pipe-like drill has been forced up to 10 feet into the mud by the explosive force of artillery powder. The samples thus obtained have given surprising information. There were four ice periods and five eras of water warmer than now in the Atlantic Ocean, new evidence of the famous ice ages of the Pleistocene geologic era which just preceded the present. The magnetic pole of the earth wandered widely as shown by small pieces of magnetic minerals, little compasses in effect, that still point the way they did when they fell to the bottom of the sea thousands upon thousands of years ago. At one period of the earth's past there was a strange age of giants among shells that fell to the ocean's bottom. A new core sampling device, hung on 7 miles of special steel cable, will go into exploratory service this spring.

YOUNG plant tissue has shown potential ability to stay young forever, in cultures prepared by Dr. Philip R. White, of the Rockefeller Institute for Medical Research, Princeton, N. J. Dr. White, who was winner of the $1,000 prize of the American Association a year ago, reported his newest researches before the closing session. The living material used in the experiments was taken from a hybrid ornamental Nicotiana plant, and consisted of stuff called callus. Plant callus is a mass of undifferentiated, unspecialized cells that form when the plant is wounded; it is essentially embryonic, or physiologically young tissue. Dr. White kept his bits of callus in specially prepared nutrient solution consisting of a sugar, certain necessary mineral salts, together with vitamins and plant hormones which have been found essential to growth. The tissue grew and grew, but the cells showed almost no tendency to mature into any of the specialized forms found in plant organs. It was immortally young. Each week he discarded part of the growth and kept the rest. At the end of the week new growth would have increased the pieces to three times their original size. This kept up for forty weeks. By that time, he calculated, had he been able to keep all of the tissue as it grew, the original piece would have increased to 10 to the 19th power (10,000,000,000,000,000,000) times its original size. For several years, Dr. White has kept cultures of roots going, unattached to any parent plant, but this is the first time that it has been possible for him to produce unspecialized tissue that is "just plant."

INDEX TO ADVERTISEMENTS

Ainsworth & Sons, Inc., Wm. 26
Ajax Electrothermic Corp. 6
Akatos, Inc. 12
American Bacteriologists, Society of 68
American Genetic Association 74
American Instrument Co. 27
American Paulin System 69
American Telephone and Telegraph Co. 38
Angel and Co., Inc., H. Reeve 4
Bakelite Corporation 19
Bausch and Lomb Optical Co. 40
Biddle Co., James G. 9
Blakiston's Son & Co., Inc. 2
Burke & James, Inc. 74
Cambridge Instrument Co., Inc. 73
Carnegie Institution of Washington, 45
Carver, Fred S. 22
Central Scientific Co. 7
Chicago Apparatus Co. 31
Clay-Adams Co., Inc. 18, 35
Collegiate Press, Inc. 61
Corning Glass Works 5
Denoyer-Geppert Co. 72
Eastern Engineering Co. 77
Eastman Kodak Co. 77
Ednal Co., Inc. 32
Edwards Brothers 68
Eff Laboratories, Inc. 34
Eimer & Amend 79
Electric Manufacturing Co. 75
Electro-Medical Laboratory, Inc. 36
Empire Laboratory Supply Co., Inc. 30, 76
Eppley Laboratory, Inc. 31
Evans, Adlard & Co., Ltd. 36
Fish-Schurman Corporation 30
Fisher Scientific Co. 20
Frober-Faybor Co. 73
Gaertner Scientific Corp. 23
General Biological Supply House, Inc. 72
Ginn and Co. 58
Graf-Apsco Co. 70
Harper & Brothers 68
Harvard Apparatus Co., Inc. 43
Harvard University Press 45
Hoeber, Inc., Paul B. 59
Hoke, Incorporated 74
Holt and Company, Henry 47
Houghton Mifflin Co. 61
International Equipment Co. 8
Jones Paper Box Co., Jesse 73
Kern Company, 35
Kewaunee Mfg. Co. 76
LaMotte Chemical Products Co. 34
Lea and Febiger 41
Leitz, Inc., E. 17
Linguaphone Institute 33
Login & Son, Inc., B. 34
Loring, J. Alden 34
McGraw-Hill Book Co. 54, 55
Macmillan Co. 62, 63, 64, 65
Matheson Company 35
Menasha Products Co. 69
Merck & Co., Inc. 37
Meylan, A. R. & J. E. 34
Mosby Co., C. V. 56, 57
National Technical Laboratories 70
Nelson, George F. 10
Oxford University Press 45
Paragon C. & C. Co. 16
Park Biological Supply 74
PerfeKtum Products Co. 13, 32, 35, 73, 78
Pfaltz and Bauer, Inc. 35
Phipps and Bird, Inc. 71
Prentice-Hall, Inc. 2
Purina Mills 78
Radio Corporation of America 39
Reinhold Publishing Corp. 66, 67
Ryker, Inc., Harrison C. 34
Saunders Co., W. B. 1, 3
Schleicher and Schüll 24
Science Press 68
Science Press Printing Co. 28, 29
Spencer Lens Co. 25
Standard Scientific Supply Corp. 14
Stanford University Press 60
Stokes Machine Co., F. J. 32
Taylor & Co., Inc., W. A. 34
Thomas Co., Arthur H. 15
Triplett Electrical Instrument Co. 33
Troemner, Henry 36
Voland and Sons, Inc. 71
Ward, Inc., Charles H. 34
Warren-Knight Co. 32, 74
Washington University, School of Medicine 45
Welch Scientific Co., W. M. 20
Wiley and Sons, Inc., John 49, 50, 51, 53
Will Corporation 11
Wilmot Castle Co. 75
Winston Co., John C. 60
Wistar Institute of Anatomy and Biology 21
Zeiss, Inc., Carl 80

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SCIENCE NEWS

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RELEASE OF ATOMIC ENERGY FROM URANIUM

URANIUM has been split with great release of energy. And the atom-splitting agency is the neutron, the electrically neutral particle discovered only seven years ago, itself a part of the hearts of atoms.

Bombard uranium with neutrons, even those with only a fraction of an electron-volt of energy, and its nucleus will split and give off millions upon millions of electron-volts of energy, up to 100,000,000 volts in actual experiments and some 200,000,000 volts theoretically.

Of course, it is not nearly so simple as this sounds, for there is the matter of producing the neutrons and arranging it so that they hit frequently enough to make the process efficient, which it is not as yet. But the energy release is astoundingly high, nevertheless, since the greatest release of atomic energy hitherto achieved consisted of 20,000,000 electron-volt gamma rays, obtained when deuterons, hearts of heavy hydrogen atoms, are smashed into lithium, a light metal. Incidentally, neutrons are given off at the same time and it is these neutrons that can be used to split uranium.

Neutrons slide into the nuclei of elements easily, and for that reason the energy-releasing bombardment to be efficient would probably need to be performed upon very pure substances, such as seldom exist now. This is probably the reason why the effect was not discovered accidentally, perhaps through a laboratory explosion.

This latest chapter of physics began in its immediate phases with researches in Berlin by Professor Otto Hahn. He observed the strange action of uranuim under neutron bombardment, but could not quite account for it. Dr. Liese Meitner, long associated with Professor Hahn, and Dr. R. Frisch, of Copenhagen, suggested the idea of uranium splitting into other elements, which although unheard of previously proved to be the case. Ironically, Dr. Meitner is now an intellectual refugee from Germany, temporarily working in Stockholm.

This work, just reported in *Die Naturwissenschaften*, became known first by private communication from Professor Hahn and later through publication. The Hahn-Meitner-Strassmann paper was the sensation of the theoretical physics conference in Washington last week under auspices of the Carnegie Institution of Washington and George Washington University.

Atom smashers were rushed into service to confirm or deny the German work. Long distance telephone and cables provided prompt communication. At least four independent confirmations have been obtained.

It was learned subsequent to the Washington conference that the experiment was confirmed in Copenhagen at Professor Niels Bohr's laboratory two weeks ago (about January 15). Professor Bohr is himself in America visiting Princeton University.

Columbia University, whose research team consists of Professor John Dunning, Dr. E. T. Booth, Dr. G. N. Glasoe, H. L. Anderson, Professor S. G. Slack, Dr. George B. Pegram and Professor Enrico Fermi, confirmed uranium's energetic splitting on Wednesday, January 25. The Carnegie Institution of Washington's Department of Terrestrial Magnetism, directed by Dr. John A. Fleming, got into action with their new atom smasher as soon as they heard of the Berlin experiment and in a historic midnight experimental conference on Saturday, January 28, demonstrated to Professor Bohr and Professor Enrico Fermi, Italian Nobelist now at Columbia University, pioneer in neutron bombardment of uranium, the reality of the energy's release. The Carnegie research crew consisted of Drs. Richard B. Roberts, R. C. Meyer, N. P. Heydenburg, L. R. Hafstad and M. A. Tuve, assisted by a Carnegie associate, Dr. Gregory Breit, of the University of Wisconsin.

On Saturday morning, January 28, the Johns Hopkins University, in experiments conducted by Dr. R. D. Fowler, confirmed the discovery also.—WATSON DAVIS.

Scientists have smashed another chemical element and made its atoms give off the tremendous quantities of energy which have long been locked within them. The element is heavy thorium.

Experiments just made with the 1,000,000-volt atom smasher at the Carnegie Institution of Washington show that high-speed neutrons (neutral atomic particles) will split thorium into two parts and yield energies so enormous that they have not yet been accurately measured.

This new experiment follows closely on the heels of the splitting of uranium, which also gives up its atomic energy in the splitting. Similar experiments on thorium have been done independently at the Johns Hopkins University. Both American researches confirm results known to have been secured a few days ago at the Institute for Theoretical Physics in Copenhagen by Dr. R. Frisch. A report of the Frisch experiments is soon to appear in *Nature*.

The release of thorium's atomic energy differs from that of uranium in that only very energetic neutrons from lithium, with energies of millions of electron-volts, seem to be able to split the element and release its energy. For uranium, both high and low energy neutrons appear able to touch off the "trigger" mechanism inside the atom that makes it split into two parts and release energies estimated at 200,000,000 electron-volts.

Investigators of the Carnegie Institution have also made a quick survey of other heavy elements—bismuth, lead, thallium, mercury, gold and tungsten—for similar results. But no conclusive evidence of splitting has been obtained for these non-radioactive elements.

While the research scientists at Carnegie are working night and day on both of their huge atom smashers, theoretical scientists are puzzling over the meaning of the astounding experiments. Most plausible suggestion now is that the action of neutrons on uranium and thorium is a kind of resonance phenomenon inside the nucleus of the atom. Neutrons smashing into the atom with some special energy can shake it and make it split apart. The enor-

mous binding energy which holds it together is released in this process.

Experiments now in progress seek to find if there is some particular neutron energy which is most efficient in releasing the atomic energy. In the case of thorium, the most efficient energy lies somewhere between 400,000 and 2,000,000 electron-volts. The Carnegie scientists systematically are narrowing these limits.—ROBERT D. POTTER.

THE NEW SUPER-NOVA

A TREMENDOUS stellar explosion—a super-nova star which probably has a brightness hundreds of millions of times that of the sun—has been reported by Professor Fritz Zwicky at the Mount Palomar Observatory of the California Institute of Technology.

The super-nova is only the eighteenth reported in astronomical history. It was first discovered by Professor Zwicky in the eastern sky with his small but powerful Schmidt type telescope-camera. On January 17 its magnitude was approximately 14. Three days later, on January 20, the brightness had increased to 12 magnitudes. It is so distant that it can not be seen with the unaided eye despite its brilliance. Its general location is almost directly east. It rises above the horizon about midnight and reaches the meridian position at 5 A.M. in the morning.

As the super-nova comes into view it is near the constellation of Leo and approximately on a line between the beta star of this constellation and the bright star Spica in the constellation of Virgo. Its position, as given in a telegram from Harvard Observatory, is right ascension 12 hours 40 minutes and declination north three degrees one minute.

The super-nova star is located near the nucleus of the nebula known as NGC 4636, listed in the nebula catalogue of Sir John Herschel, the nineteenth century British astronomer, as being a bright, large and irregularly shaped nebula. The nebula is resolvable into individual stars. It is one of these stars which apparently has flared up into super-brilliance.

THEORY OF IMMUNITY TO INFANTILE PARALYSIS

THE commonly held theory of why most of the population is immune to infantile paralysis is getting its first direct experimental test in the laboratories of the Johns Hopkins Medical School.

The theory is that man becomes immune to this disease by repeated slight attacks in which the virus or germ invades the nervous system without causing paralysis and without the knowledge of the person thus acquiring his immunity. It is hoped results of the test, now only in the beginning stages, might help in finding a way to make the rest of the population immune to the malady.

To learn whether the theory is true, or at least to learn something more about immunity to the disease, is the object of one part of the research Dr. Howard A. Howe is conducting at Hopkins. This research was begun under a grant from the President's Birthday Ball Commission for Infantile Paralysis Research. The study is being made with monkeys, in the hope that the findings may also apply to man.

Monkeys become permanently immune to this disease only by surviving an actual paralyzing attack of it. Dr. Howe has found a way to give them the disease without causing paralysis. He isolates the nerve connections between the central nervous system, including the spinal cord, and that part of the monkey's brain which receives sensations of smell. This isolated bit of nerve tissue still sends nerves down into the nose but is no longer connected with the rest of the brain.

When these animals get a dose of infantile paralysis virus in their noses, they develop fever at the same time as normal monkeys infected in the same way. The normal animals, however, become paralyzed and die, while the others remain healthy and active. The conclusion is that the treated animals have suffered a non-paralyzing attack of infantile paralysis in the isolated bit of olfactory brain. Whether or not the monkeys have acquired immunity to the disease is not yet known. Dr. Howe plans to investigate that point next.

VIRUS DISEASE OF ELMS

A NEW-FOUND, deadly disease, caused by a filterable virus instead of a fungus, has killed many hundreds of American elms in Ohio. Plant pathologists of the U. S. Department of Agriculture fear that it will prove even more destructive than the so-called Dutch elm disease that they have been fighting for several years in the neighborhood of New York, unless its cause can be discovered and means for combating it developed.

The disease was first called to the attention of government scientists in Ironton and Dayton, Ohio. During three years it killed more than 1,000 out of about 1,800 elms in Chillicothe. It is now rampant in Columbus. It was at first thought to be a "city" disease, but it has since been found in forest trees in West Virginia, northern Kentucky and southern Indiana and Illinois.

The symptoms are: first, a slight shriveling and brittleness in the leaves; then a rotting of the roots and the inner bark of the trunk. Within a few months the tree may be dead.

The new disease is not related to the Dutch elm disease of the Northeast. That is caused by a fungus which is carried about by a beetle. The Ohio Valley elm disease has been proved to be due to a filterable virus—a mysterious, self-multiplying something that is too small to be seen through a microscope. How it gets from one tree to another is still unknown. The present outbreak is the first known instance of a virus disease causing a fatal epidemic among trees.

Since the disease may have gained a foothold outside the Ohio Valley, government authorities wish to be informed regarding trees showing symptoms of its presence. Notices should be sent to the Division of Forest Pathology, U. S. Department of Agriculture, Washington, D. C. Because the disease is caused by a virus that can not be isolated and identified, there is no point in sending diseased samples.

THE NOVACHORD, A NEW ELECTRIC MUSICAL INSTRUMENT

A SINGLE versatile new electric musical instrument, looking for all the world like an old-fashioned spinet, is the Novachord, which uses vacuum tubes instead of piano or violin strings or the pipes of a wind instrument. It was

invented by Laurens Hammond, inventor of the Hammond electric organ, which likewise uses electric currents to produce its music instead of the familiar banks of pipes.

Requiring only to be plugged into a household light outlet, the Novachord is smaller than a grand piano. It contains no pipes, reeds, strings, hammers or vibrating parts. It has a keyboard of seventy-two notes which are, however, played exactly like a piano and has the regulation piano sustaining pedal and a pedal for controlling volume. Punching the keyboard and using the other controls determines the type of electric wave generated in the vacuum tubes. This electric wave is then converted into sound in much the same method as a radio.

Its imitating abilities it owes to the fact that the person playing it can change at will the two chief varying characteristics which give each musical instrument its identity. A group of controls mounted on the front panel above the keyboard makes this possible. One group on the left controls the actual tone color, while the other varies the "envelope." The player can thus pick the tone color and "envelope" he desires.

Mr. Hammond does not consider the Novachord, however, strictly an imitative instrument. It does, however, bring up distinct new possibilities for varied orchestral effects and for greater diversification of home entertainment.

SOME PAPERS PRESENTED AT THE RICHMOND MEETING

BACTERIA are scarce in the ocean and large fresh-water lakes primarily because these big bodies of water do not give them access to solid surfaces to which they apparently like to cling, according to Dr. Claude E. ZoBell, of the Scripps Institution of Oceanography. Various other factors which have been offered in explanation, such as the lethal effect of sunlight, and the presence of one-celled animals that eat the bacteria, he considers to be of less importance. In various experiments with Pacific Ocean water and with fresh water from Wisconsin lakes, Dr. ZoBell found that there was a definite correlation between the numbers of bacteria present and the ratio between the volume of the water and the area of solid surface presented. Bacteria numbers increased enormously when he artificially increased the solid surface by introducing glass wool, asbestos fibers, or other finely divided solids or colloids.

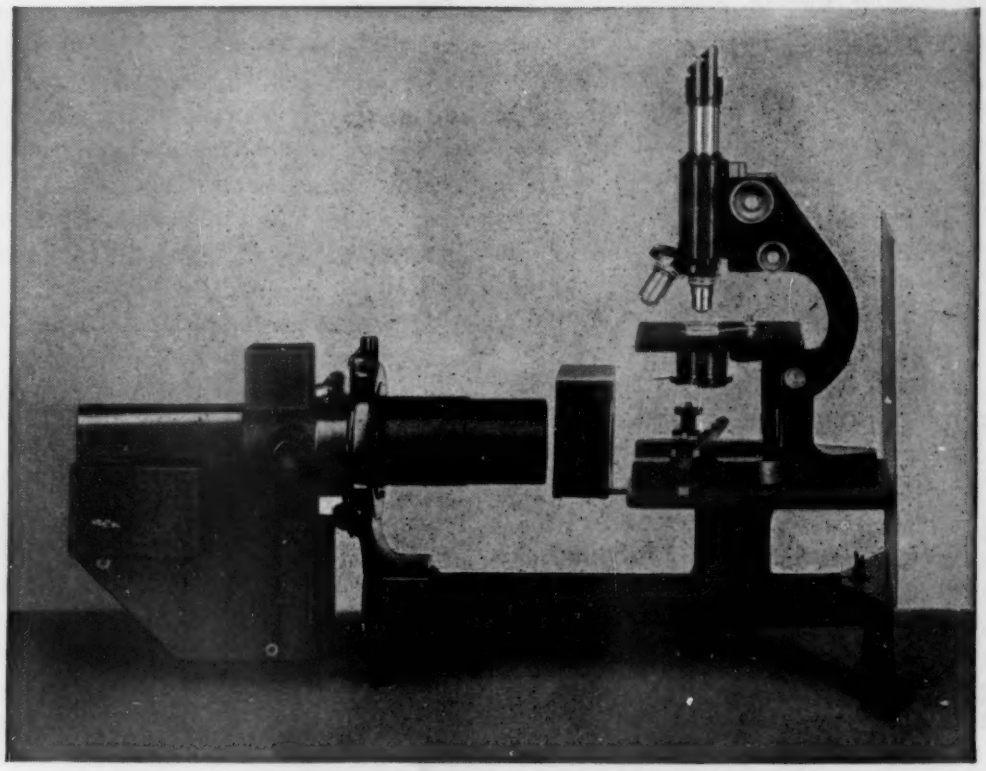
A STEP toward the more adequate understanding of the minute parasites that damage the health of animals and human beings has been taken through the successful "in vitro" cultivation in the laboratory of the twisted wire worm of sheep and other cud-chewing animals. Drs. R. W. Glaser and Norman R. Stoll, of the Rockefeller Institute for Medical Research laboratories at Princeton, N. J., reported that they had raised this worm, scientifically known as *Haemonchus contortus*, through the four larval stages. A germ-free diet, consisting of liver extract, agar, rabbit kidney and killed yeast, was made available in test-tubes to the worm eggs carefully made germ-free by sterilizing agents. In this way the worms were taken through their two free-living stages. These test-tube worms, when fed to a three-months-old, bottle-raised lamb which was worm-free, produced a normal infection of the worm parasites. Using a slightly different food medium, they were carried through the two further larval stages, which are parasitic.

A NEW chemical victory over disease appeared in the report of Drs. Willard H. Wright and Frederick J. Brady, of the U. S. Public Health Service. The victorious chemical remedy is gentian violet, familiar to bacteriologists as a stain for showing up microbes under the microscope. The disease for which it was used is oxyuriasis, more familiary known as pinworm infestation. Public health officials reported that, given in tablet form, this dye cured over 90 per cent. of the patients treated. Control of this condition, it was emphasized, depends on treatment of all members of a family or household.

THE first known change in the chemical nature of chlorophyll, the green coloring matter in leaves that enables plants to make food, was reported by Dr. O. L. Inman, of Antioch College, and Dr. A. F. Blakeslee, of the Carnegie Institution of Washington. Seeds of the common jimson-weed were treated with x-rays in Dr. Blakeslee's laboratory. Something must have happened to the chromosomes that carry the chlorophyll-determining genes or hereditary factors, for when the plants grew their leaves contained chlorophyll unlike any hitherto known. Examined under the spectroscope, it was proved to absorb light in a pattern different from that shown by other chlorophyll. However, it was still able to perform its natural food-making function. Since chlorophyll is remarkably stable chemically, and appears to be the same substance in all known species of green plants, this production of a new kind, with different chemical make-up, has created something of a stir in botanical and chemical circles.

WHY some plants can form fruits from flowers that are never pollenated was explained by Professor F. G. Gustafson, of the University of Michigan. Some time ago, Professor Gustafson created something of a stir when he produced fruits from unpollenated flowers by means of spraying them with growth-promoting chemicals. Now he has examined the ovaries of flowers that naturally produce fruits without being pollenated, and has found them to contain relatively large amounts of the natural growth-promoting substances, or auxins. He suggested that this high auxin content may account rather generally for the production of unpollenated, seedless fruits.

SPROUTING of seed potato pieces can be prevented and started again at will, reported Dr. John D. Guthrie, of the Boyce Thompson Institute for Plant Research. Pieces that would normally grow with no hesitation at all can have their sprouting held up by treatment with a chemical known as potassium naphthaleneacetate. The spell of this chemical can be broken with another, ethylene chlorhydrin, which caused them to sprout most vigorously. Dr. Guthrie suggested two possible practical applications: The treatment may be used (1) to retard the sprouting of potatoes and other plants during storage, and (2) to delay the blossoming of fruit buds that have a tendency to come out while there is still danger of frost.



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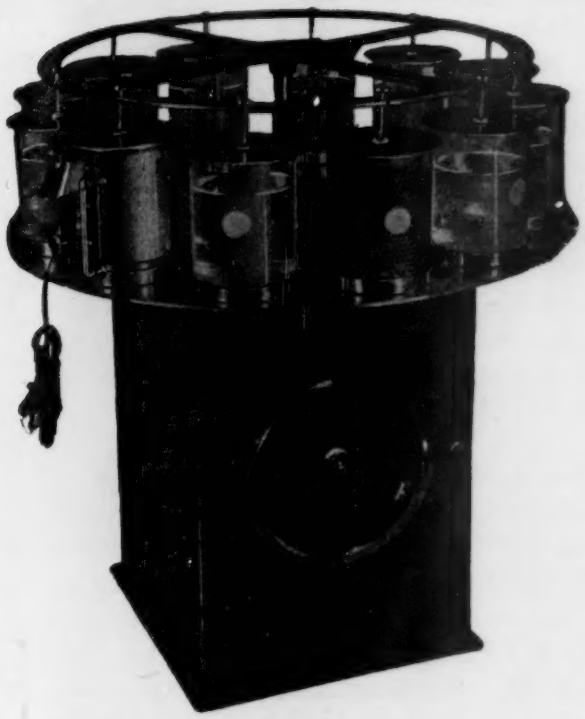

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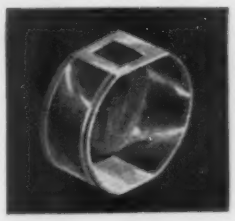

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SCIENCE NEWS

Science Service, Washington, D. C.

THE NEW CYCLOTRON AT CORNELL UNIVERSITY

AN atom smasher of new type, producing high-speed particles at relatively low voltages with safety to the operator, promises a further understanding of the structure of the nuclei of the atoms and the forces holding them together. This new tool of science has been perfected at Cornell University after more than three years' work.

It is an eight-foot glass tube, six inches in diameter, with a radio short-wave generator providing an alternating potential which changes ten million times each second. Operating very much like the distributing system of an automobile where the spark plugs ignite each cylinder in rotation, the short-wave generator alternately charges the segments of the tube through which the particles have to pass on their way to the target. In contrast to the well-known cyclotron which speeds up its atomic bullets in a merry-go-round motion, it accelerates the projectiles in a line and is called a linear resonant accelerator by its designer, Dr. Lloyd P. Smith, professor of physics at Cornell. With Dr. Paul L. Hartman, of Reno, Nevada, Professor Smith has completed his machine at a cost of about $7,000 and it is now in successful operation.

Advantages claimed for the new tool are: (1) Greater accessibility of the ion source and the target and the absence of danger from electrical shock; (2) ability to accelerate heavy atoms more successfully than the cyclotron; (3) the resonant property of the system serves to select out the atom desired as a bullet—thereby saving the target from unnecessary bombardment; (4) a vacuum for the tube is produced by a simpler process and can provide a greater beam density of accelerated particles than the cyclotron. An original voltage of 50,000 to 70,000 volts is stepped up to about a half million volts and the tube produces ions of higher intensity otherwise available only by use of voltages running into the millions.

THE THRESHOLD TREATMENT OF WATER

SOFT water that will neither produce objectionable scale or corrode plumbing can be produced cheaply from water of the hardest variety by dissolving in it a tiny amount of a simple chemical, sodium hexametaphosphate, two water supply engineers have reported.

The new treatment, which requires only two parts of the chemical per million parts of water, was first tested at Delaware, Ohio, and has been put into use in the water supply system of Columbus by Charles P. Hoover, superintendent of the water purification plant in Columbus, and Owen Rice, of the Hall Laboratories in Pittsburgh.

Known as the "threshold treatment," it solves difficult but extremely important problems which the average citizen may never be in a position to realize and which have plagued water supply engineers for years.

Hard water, unless previously softened by either acid treatment or by lime softening, makes it impossible for a user to get a good soap lather when washing. In industrial plants, it deposits hard scale in boilers and pipes, making them less efficient and leading eventually to breakdowns.

But the lime softening process is difficult to control, and the acid treatment processes have an undesirable feature—the corrosion of piping.

The sodium hexametaphosphate may be added before filtration, but the best procedure is the addition of this chemical after filtration. It is entirely non-toxic in its effects on human beings. Applied first to the specific water supply problems of some factories, the new method was thoroughly tested for toxicity before the Ohio State Board of Health would permit its trial in a city water system.

The stabilization effects are found even at temperatures approaching the boiling point of water, making it extremely useful in treating boiler waters. Trouble with scale in hot water heaters is often encountered even following partial softening or the addition of lime or soda ash for corrosion control, in the absence of the sodium hexametaphosphate.

In the acid treatment lime or soda ash are frequently added to eliminate the danger of corrosion. In those cases a slight protective scale is wanted. But the difficulty is found in adding exactly enough lime or soda ash to deposit just enough scale and no more.

EPIDEMICS OF TREE DISEASES

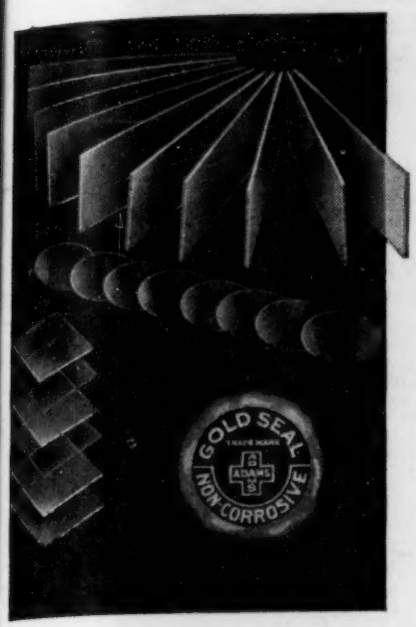
THE U. S. Department of Agriculture reports that London plane trees, among the few species that can stand the smoky air and other unfavorable conditions of city life, are now menaced by a killing epidemic disease. Seven thousand of the trees are dead in the Philadelphia region, and 700 in Baltimore. The disease has also appeared in Washington. The infestation is a slow killer. In the first year, cankers appear in the bark of the trunk and large limbs and dark streaks in the young wood. In the second year the leaves thin out. The tree may die then, or linger one or more years longer.

The London plane is a cross between the American and European plane trees or sycamores. It is widely used as a shade tree along streets and in downtown parks because of its hardiness under city conditions. Its disappearance would denude many American city streets and leave city foresters and park commissioners at a loss to find an equally good substitute.

R. Kent Beattie, plant pathologist of the Department of Agriculture, is seeking information regarding the distribution of diseased trees. It is requested that chips of young wood from planes or sycamores suspected of having the disease be sent to the Division of Forest Pathology, U. S. Department of Agriculture.

SUDDEN invasion by an enemy which is killing its victims so rapidly that there may be no chance to fight back is also announced by the department.

The victims are persimmon trees, valuable members of



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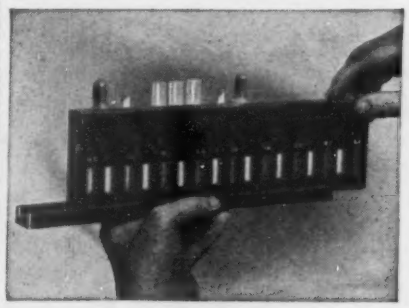

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The enemy, a fungus, was first discovered two summers ago, killing persimmon trees near Nashville, Tennessee. Last summer it was found to be wide-spread in the South, from South Carolina across the Gulf States region to Mississippi. "Explosive" is the term used by the government scientists in describing its spread.

The fungus not only kills the trees with the speed of a ravaging plague, but it rots and ruins the wood in record time. Trees killed last summer are already decayed into uselessness. No way of fighting the disease has yet been discovered. Attention is being turned on a search for possible resistant native specimens, which can be quickly propagated by root cuttings. In case these are not found, the next best thing is to go to eastern Asia for the persimmon species that grow there, for these are apparently immune to the fungus.

THE NEW ROBOT PILOT

AVIATION has a new robot pilot which automatically warns the men in the cockpit if something goes wrong. It is arousing wide interest among airmen as a possible safety advance of first rank importance.

Developed by engineers of the Curtiss-Wright Corporation's St. Louis Airplane Division under C. W. France and George Page, Jr., the new robot can flash on 90 lights to announce as many kinds of "trouble" before it happens. It "watches" the plane's instruments continually. If landing flaps are not operating properly when the plane comes in for a landing, for example, a light labeled "wing flaps" flashes on and calls the human pilot's attention to the situation. If the airport battery car is still plugged in when the pilot gets ready to start, the indicator lights another lamp. Failure to notice a dial that shows something out of kilter will be prevented by such a device. It may help prevent accidents in the future by simplifying the task of pilots in the midst of an increasingly complex welter of instruments.

The "tell-tale" indicator is the second robot pilot to find its way into the cockpit. The first, the gyro-pilot, is to-day at the controls nine tenths of the time commercial airliners are aloft.

Ten pre-selector switches enable the pilot to set the system for each of the main operations concerned in flying an airliner. Pressing one of the switches picks out the particular combination of instrument readings and control adjustments proper to the chosen operation. Deviation from the proper combination causes the revealing light to flash on. Switches are provided for test, start, taxi, take-off, left engine, right engine, cruise, landing, stop and off.

The indicator panel is similar to the indicating signal system used by the railroads and electric power industry to warn of danger or improper operation. Indicator lights for many instruments are used now, but this is the first time it has been widely applied.

With the use of the "tell-tale" system, constant scrutinizing of many instruments by the pilots is eliminated. Simplification of the instrument board of the first plane on which it is installed, the *Curtiss-Wright 20*, a 30-passenger twin-engined plane nearing completion in St. Louis, is another result achieved.

Pilot fatigue is decreased, its makers claim, and shouting of orders between pilot and co-pilot is eliminated.

LACK OF RAW MATERIALS IN SUDETENLAND

LACK of raw materials, made worse by the conquest of predominantly urban and industrial Austria and Sudetenland, is forcing an economic crisis in Nazi Germany. Germany is to-day farther away from self-sufficiency than at any time in the last two or three years, despite frantic efforts to free herself from dependence on foreign imports, particularly those for which she must pay cash.

Separated by a new economic barrier from its natural agricultural hinterland and from former world markets, the Sudetenland has placed a heavy burden on the precariously-balanced German economy. Food for 3,500,000 mouths and raw materials for her factories must now be imported. The boycott of German goods, induced partly by governmental opposition in several countries to Nazi barter trade practices and partly by popular anger at the Nazi régime, has reduced sharply foreign demand for the consumer goods made in the area. Besides, these factories compete with already existing German plants. More cash has had to go out; less has come in.

This development entirely confirms predictions made at the time the Czechs gave in to the threat of war. Seemingly accurate reports from Berlin indicate the trade deficit for old Germany amounted in 1938 to about 190,000,000 marks, while that for Greater Germany ran up to about 430,000,000 marks. A large part of this 240,000,000 mark deficit for the new areas can be laid to the needs of the Sudeten region. This deficit is even more serious than it seems, for they have been running it up for only a part of the year. Austria was annexed in March, the Sudeten districts in September.

Besides heavy chemical industries, Sudeten factories manufacture consumer goods such as toys, novelties, imitation jewelry, glassware, porcelain and textiles. The textile establishment is extensive, much of it having served a large export market. Insufficient quantities of the raw materials going into these products are found in Germany. Machine and raw material imports from the United States have increased.

Annexation of Austria has posed a similar problem, which the Nazis haven't been able to solve either. The bulk of the tiny nation's population was concentrated in Vienna, its industries were almost without exception those that would compete with existing German plants. Besides, tourists, one of former Austria's important sources of foreign exchange, have just stopped going to Vienna since the Germans changed its character from that of the delightful, "gemuetlich" city of old.

ITEMS

GENERAL use of sulfapyridine, the sensational new drug proclaimed particularly effective for treating pneu-

monia, is not warranted at the present time, in the opinion of the council on pharmacy and chemistry of the American Medical Association. The association regards the drug, which is related to sulfanilamide, as definitely experimental in status and asks that it be used only by properly qualified persons for investigations of its value in pneumococci, severe staphylococci and Friedlander's bacillary infections.

FRUITS (including such vegetables as tomatoes and eggplants) develop because of the auxin concentration in their flesh. Auxin is the chemical compound that stimulates growth in plants. Discovery of auxin's importance in fruit growth resulted from researches by Professor G. Gustafson, of the University of Michigan. He found that auxin is highly concentrated in the beginning stages of seedless fruits, and also near the seeds in other fruits.

DANGER of disease carried in milk exists in 726 municipalities in the United States. These cities and towns, the U. S. Public Health Service finds, "are still subjecting their citizens to milk-borne diseases by failure properly to require all milk distributors to show safe milk ratings." These 726 municipalities are among the 874 in the nation that have adopted the uniform milk ordinance recommended by the Service. Of the entire number, however, only 148 are enforcing the ordinance adequately. From the standpoint of milk-borne disease, it is reported that the safest communities are those in which all milk is pasteurized and in which the pasteurized-milk rating is 90 per cent. or more. Diseases that can be carried by milk are tuberculosis, typhoid fever, scarlet fever, diphtheria, septic sore throat and undulant or Malta fever.

THE most powerful permanent magnet in the world—for its size—has been developed in the research laboratories of the General Electric Company at Schenectady, New York. Only half the size of the eraser on a lead pencil, it will lift a flatiron weighing five pounds. Its magnetic attraction is several times as strong as that in any previous magnet. The strongly magnetic alloy forming the magnet can be used too in electrical equipment to replace electromagnets that require current.

UNIVERSITIES of the nation having the largest research expenditures are California, Chicago, Columbia, Harvard, Illinois and Michigan, according to a survey contained in the report of the National Resources Committee. These six schools spend over $2,000,000 a year on research each. In the group spending between $1,500,000 and $2,000,000 a year for research are Cornell, Minnesota, Wisconsin and Yale. In the $1,000,000 to $1,500,000 brackets are four schools: Massachusetts Institute of Technology, New York University, the Ohio State University and the University of Pennsylvania. Spending between $500,000 and $1,000,000 yearly for research are: Duke, the University of Iowa, the Iowa State College, the Johns Hopkins, Missouri, Nebraska, Northwestern, Penn State, Princeton, Purdue, Rochester, Rutgers, Stanford and Texas A. and M. The list, states the report, is not complete and the estimates are probably too low rather than too high.

MINORCA, link in the French lifeline between Marseilles and North Africa, is the second largest island of the Balearic group. While these islands have been fought over and handed from one power to another from Roman days and are now reported to be surrendered to Spanish rebels, their fate has been bound with that of Spain since 1349. The Balearic Islands were long a stronghold of pirates, and were conquered by Romans on this charge in the second century B.C. In the middle ages, the islands were a separate corsair kingdom, preying on coast city trade. Minorca's harbor, Port Mahon, is one of the best in the Mediterranean. The island has about 50,000 people, mainly farmers and cattle growers. Its area is 260 square miles.

AERIAL photographs vital to America's future now have a new home, half buried in a Virginia hillside just across the Potomac River from the nation's capital. Those attending the meeting in Washington on January 13 of the American Society of Photogrammetry made a special inspection trip to the new storage vaults which can hold 16,000 cans of aerial film that would weigh four tons. The vault, only recently completed, was built for the Soil Conservation Service to house its photographs. From these strips of film—nine inches across and 100 feet long—will be obtained information on which important decisions on erosion studies, land use planning and flood control will be based. Unpretentious in appearance, the storage vault contains 10 rooms of 1,000 cubic feet capacity each, which will house the film. Each room is a distinct unit and is separated from other rooms by concrete walls and double doors. At present the hillside vault is unheated. It lies mostly below ground level and an even, cool temperature is attained. Eventually it is planned to have the whole structure air-conditioned to attain the optimum conditions of temperature and humidity for film storage.

STUDIES of the Great Nebula centering around the brilliant constellation of Orion in the south these winter evenings are leading astronomers to suspect that they may be watching and photographing through their telescopes a gigantic astronomical "building block" out of which our galaxy of stars is composed. This hypothesis, presented at the meeting of the American Astronomical Society by Dr. V. M. Slipher, of Lowell Observatory, Flagstaff, Ariz., suggests that the cluster of hot stars which make up Orion and their surrounding nebulae may have had a common origin in some gigantic stellar explosion. Nova and super nova stars are examples of stellar explosion wherein a rather ordinary star will suddenly explode and flare up into a great brilliant one and then, after a few years, reduce its luminosity to low values and pass into stellar obscurity. The explosion which could have created the constellation of Orion and its accompanying nebula was something far more stupendous than such an explosion.

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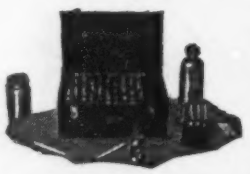

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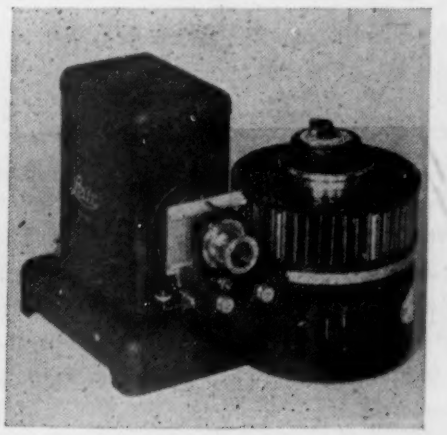

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SCIENCE NEWS

Science Service, Washington, D. C.

HYDROGEN AND HELIUM

PROFESSOR HENRY NORRIS RUSSELL, of Princeton University, at the meeting sponsored by the American Philosophical Society and the Franklin Institute summarizing current knowledge of the stars and the planets, pointed out that hydrogen is the fuel and helium is the ash of the stellar engine which produces the vast amounts of energy liberated by the stars and the sun through the ages.

Speeding bits of hydrogen atoms are now believed to bring about spontaneous disintegration of chemical elements and release vast amounts of energy. Crediting Professor H. A. Bethe, of Cornell University, with having developed current concepts on the source of stellar energy, Professor Russell said that as the various elements were broken up they gave off helium as the end product. Thus helium—the light stable gas—is the "ash" of stellar energy production.

From purely mathematical theories on the behavior of atomic nuclei when they are smashed by other atomic particles inside the sun and star, it is possible to explain why many of the lighter elements—lithium, beryllium and boron—appear not to be present in the sun to any great extent. Long since they have been transmuted into helium, giving off radiation.

It is only when carbon in the sun is considered that the destruction of the elements changes. For carbon, explained Professor Russell, a whole series of transmutations occur which release large amounts of gamma radiation and which end up by recreating the carbon again along with more helium. Carbon, in effect, acts as the catalyst.

The sun will keep on shining for another 10,000,000,000 years, Professor Russell estimated, and each 100,000,000 years it will grow enough hotter to raise the earth's temperature by one degree Fahrenheit.

Thus if nothing happens to the earth in the meantime it is going to be about 168 degrees on the earth in the year 100,001,938 A.D. instead of 68 degrees average as it is now. These supertropical temperatures would probably melt all the ice caps at the earth's poles, raise the level of the ocean many feet and have other equally intriguing implications.—ROBERT D. POTTER.

THE ATMOSPHERES OF STARS

NEW stellar studies have revealed that some of the bright stars in the sky have atmospheres which extend far beyond the shining surface ordinarily seen, according to a paper given in the symposium on "Progress in Astrophysics" by Professor Otto Struve, of the Yerkes Observatory.

The eclipsing variable star, known as Zeta Aurigae, has a tenuous atmosphere extending more than 62,000,000 miles about the gleaming surface of the star. For Epsilon Aurigae the height of absorbing atmosphere is estimated at more than 180,000,000 miles. Several other stars, known astronomically as the B type, have atmospheres whose height is about five times the radius of the star itself.

An explanation of the physical nature of these stellar atmospheres is one of the puzzles of modern astronomy. It is necessary to take into account the unusual behavior of the energy levels of individual atoms in the stellar atmosphere. Transition of electrons between energy levels in atoms is the mechanism that produces the emission and absorption of light, Professor Struve explained. In some cases it is necessary to assume that the radiation is produced by atoms having so-called "metastable" energy levels which produce different kinds of spectrum lines than do the ordinary stable energy levels.

Using new methods, which Professor Struve outlined, astronomers have now made analyses of the atmospheric properties of such famous stars as Nova Herculis, P Cygni and Beta Lyrae.—ROBERT D. POTTER.

FUNGUS DISEASE OF AMERICAN TREES

FOREIGN enemies are entrenched in America on a dozen fronts. Their destructive activities are directed not at cities and the people who dwell therein but at our wealth of trees. Their havoc has already run into the hundreds of millions, and the end is not yet in sight. Against some of the worst attacks no adequate defense has been found.

Newest outbreaks are of diseases that threaten two favorite street trees, the American elm and the London plane or sycamore. Elms, already losers from the fungus-caused Dutch elm disease in the region around New York, are now suffering from a killing virus in the Ohio Valley. At first thought to be a "town" ailment, the disease has now been found in forest elms in West Virginia.

The London plane tree, a hybrid between European and American sycamores, is particularly valued for street plantings because it can endure city smoke. The fungus that is killing it in Philadelphia and Baltimore, and that threatens to spread to other cities, is therefore a particular foe of city foresters and park commissioners.

Two other new diseases are menacing forest trees that are valuable alike for their wood and as sources of food for wildlife, according to G. F. Gravatt, plant pathologist in the U. S. Department of Agriculture. One is a virus that has been found attacking oaks in Wisconsin. Although its distribution is limited as yet, foresters and wildlife administrators are alarmed over the possibility of its spread.

The other disease threatens to wipe out the American persimmon, valued as a source of hard wood for golf clubs and of food for wild birds and mammals, as well as a soil-binder in erosion control. It first appeared near Nashville, Tenn., in the summer of 1937. Last summer, R. Kent Beattie, of the U. S. Department of Agriculture, found it all the way from South Carolina to Mississippi. It kills the trees in a few weeks, and spreads with explosive rapidity.

As if the plague of chestnut blight that started something over a generation ago and has practically wiped out the American chestnut were not enough, a new enemy is attacking the few remaining chestnut trees in the South that the wilt has not yet reached. It is a root-rot fungus,

and it kills not only the chestnut trees but their smaller-fruited relatives, the chinquapins, which are an even more important source of food for game, especially wild turkeys.

A deadly combination of a scale insect and a fungus is killing the beech trees in New England. It got started in Nova Scotia or New Brunswick, and presently crossed the Maine boundary. Beechnuts are an important wildlife food, and the probable replacement of dead beeches by maples will make the forest a decidedly leaner larder for game.

A double invasion, one disease from Europe and one from Asia, has converged upon certain species of willow, and is killing the trees in great numbers. Willows are irreplaceable in certain types of soil conservation plantings, and they are also favored browse for deer and other game animals.

Against all these enemies of our trees, scientists are struggling valiantly, though it is an uphill fight all along the line. The persimmon blight has spread so rapidly that there is no use trying to get rid of it by destroying infected trees, as is being done in the battle against the Dutch elm disease. The attack on the chestnut ended in disaster long ago. Whether the new root rot that is killing chinquapins will wipe them out also is still uncertain, but the prospects are not bright.

In some cases, doomed native species can be replaced with resistant trees brought from other countries. Mr. Beattie spent several years in the Orient, seeking suitable chestnuts, and brought back a number of promising varieties. The same may be done in the case of the persimmon, for Chinese and Japanese persimmons have been found to be immune to the fungus. Hybrids between susceptible native trees and resistant foreign species are sometimes resistant.

No possible replacement tree has yet been found for the American elm, however. European elms are as susceptible as our own; indeed, it was from imported European logs that the fungus got its start in this country, Chinese elms appear to be resistant, but they are not really equivalent to the American elms. So the fight on that front will have to continue as an effort at absolute elimination.—FRANK THONE.

FOSSIL TOOTH FROM CREATURE LINKING MAN AND APE FOUND

A FOSSIL tooth, exceedingly well preserved, has been found in the Sterkfontein district of South Africa. It promises to furnish another important link between man and the ape. This is reported by Professor Middleton Shaw, head of the dental department of Witwatersrand University, and serves to strengthen the researches of Dr. Robert Broom.

"A single tooth may appear to be very inadequate evidence upon which to base conclusions," Professor Shaw said, "but many important extinct forms are known only from a single tooth. Moreover, the present specimen is beautifully preserved and its characters are so distinctive that there is adequate evidence that it belongs either to a man or a man-like ape closely allied to, if not identical with, the man-ape of which remains have recently been discovered at Sterkfontein by Dr. Robert Broom.

"A detailed report on the tooth will appear in due course, but in the meantime I am prepared to state that the discovery confirms the view that the man-apes which once inhabited the Sterkfontein district were closely related to the ancestors of modern man, and in fact, as far as their teeth are concerned, were hardly distinguishable from primitive modern man.

"The age of the new Sterkfontein specimen is probably between 50,000 and 100,000 years. The rock in which the specimen was discovered was found near the Sterkfontein caves by Dr. Julius Statz and given by him to Professor Shaw."

ITEMS

A DIFFERENCE of 110 degrees Fahrenheit between the lowest and highest minimum temperatures in the United States is the unusual record reported by the U. S. Weather Bureau. Lowest temperature at Havre, Mont., was 49 degrees below zero. At the same time, the thermometer in extreme southern Florida did not drop below 70 degrees above zero all week.

DR. PAUL YU-PIN, Catholic bishop of Nanking, has predicted the outbreak of pestilence throughout China during the coming summer. Diseases of several kinds, including typhus, plague and others endemic to the Far East, will break out as the result of the privations which the Chinese people have suffered in their war against the Japanese invaders. Bishop Yu-Pin said, in appealing for American aid, that the epidemics would strike both the areas still under Chinese control and those occupied by Japan. In asking for assistance, he suggested that American medicines be sent, because drug and surgical supply factories in China have all been destroyed.

THE number of deaf adults could be reduced by 50 per cent. if the ears of school children in the primary grades were periodically examined and, when necessary, treated. This is the opinion expressed by Drs. S. J. Crowe and John W. Baylor, of the Johns Hopkins University School of Medicine, in the leading article in the forthcoming issue of the *Journal* of the American Medical Association. The most common type of middle ear deafness in adults begins during childhood. Often it progresses so gradually and insidiously that it may not become evident until it is too late to correct the primary trouble and to restore the hearing.

A SIMPLE new blood test aiding in recognizing malaria has been announced by the U. S. Public Health Service. The new test was devised by H. O. Proske, chief medical technician, and Dr. Robert B. Watson, senior malariologist of the Tennessee Valley Authority. The test is based on the fact that a certain fraction of the proteins in blood, the euglobulins, is increased in most cases of malaria, and this increase can be shown by a chemical color test. Malaria can not always be diagnosed from the symptoms, it is explained, because many of these are similar to those of other diseases. Clinching the diagnosis by searching for the malaria germs in the blood is also sometimes difficult, especially if the number of these germs in the blood is small. The new test, which is easy to perform in any clinical laboratory, gave 97.4 per cent. positive reactions in a series of known malaria cases as compared with 81.9 per cent. found by microscopic examination.

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SCIENCE NEWS

Science Service, Washington, D. C.

DESIGNATING COLORS

SCIENTISTS are attacking one of the most difficult of all jobs known to man—the task of bringing some semblance of order out of the chaos of terms designating colors. Baby blue, sky blue, Eleanor blue and other terms much more fantastic may be useful as words, but they tell nothing about actual colors. And yet colors and their proper scientific designation are most important in many fields; in medicine, paper-making, textiles, industry generally, lighting, psychology and fashion.

It was only a few years ago that colorists found there were fifty-nine different colors all designated by the same name on the color charts of manufacturers. And, in another case, there were forty-seven quite similar colors all designated by different color names.

At the meeting of the Inter-Society Color Council reports were made of the newest advances in building up a true simple chart of colors which would replace the hodge-podge of names now used except for advertising purposes.

Dr. E. N. Gathercoal, of the University of Illinois School of Pharmacy, described the usefulness of proper color terms for medicine, particularly the description of drugs by their color. In one U. S. Pharmacopoeia, Dr. Gathercoal said, he had seen the term "blackish white" as a color designation for a drug. The use of so startling and yet meaningless term set scientists to a study of colors indicated in this standard formulary of drugs. About 2,500 color designations were found. Great simplification of color designations has now been found possible until the number of terms needed is only a few and variations of shade are possible by use of a careful list of a few qualifying adjectives.—ROBERT D. POTTER.

X-RAY MACHINES FOR CANCER TREATMENT

THERE has been constructed, at the Massachusetts Institute of Technology, a 1,250,000-volt electrostatic x-ray generator so compact it fits in a small tank three feet in diameter and nine feet high, according to the report to the American Physical Society of Professor John G. Trump.

Only one tenth the size of its million-volt predecessor, built in 1937 for the Huntington Memorial Cancer Hospital in Boston, the new generator will go into the tumor clinic of Massachusetts General Hospital.

Superior insulating qualities of gases under pressure, permitting insulation of very high voltages without loss by spark discharges, were exploited in the development. At present the generator is operated under air pressure of 150 pounds per square inch. Value of other gases as insulating mediums is being explored. Operation of the generator requires only four kilowatts of electric power, costing about eight cents an hour.

A new mercury bath method of directing the piercing 1,000,000-volt x-rays of another powerful machine, to be installed this spring in the new quarters of the Memorial Hospital in New York City, important American center for cancer treatment, was also described to the meeting by Dr. G. Failla, physicist at the hospital.

Small hollow boxes are sunk in a bath of mercury and will serve as exit slits for the powerful x-ray beams, to give angular control of the radiation to radiate hidden tumors within the body of a patient. The heavy mercury around the boxes stops the radiation, which goes through the boxes easily.

THE EINSTEIN THEORY AND THE NUCLEAR STRUCTURE OF ATOMS

DR. NATHAN ROSEN, a young physicist now working on a WPA project at Massachusetts Institute of Technology, has announced modifications of Einstein's general theory of relativity which may make it possible to apply this basic theory to the problems of atomic nuclei.

In a report to the meeting of the American Physical Society, Dr. Rosen explained that the framework of general relativity theory is uniquely determined by arbitrarily set "laws." To adapt the theory to the nucleus, it is necessary to introduce a change into the basic framework of relativity. This change consists of not only working mathematically with a Riemannian, or curved, space, as does present relativity theory, but also adding mathematical symbols common to Euclidean, or flat, space. Dr. Rosen has been able to devise formulae which appear to make gravitation a factor in nuclear problems, something which previously has not appeared in theories about the hearts of atoms.

For one thing, the relativity theory principle of the equivalence of clocks does not apply in the Rosen variety of the theory.

The relativity theory predicts that it is impossible to distinguish between an experiment with clocks performed in a closed room (an elevator) stationary with relation to the field of gravity and an experiment performed in a closed room being accelerated far out in space where gravitational forces are negligible. By Dr. Rosen's equations, however, this situation would no longer exist. Where the clocks come into the picture is that the oscillations of electrons in an atom, which make them emit light, are really just little atomic clocks.

The "red shift" light rays due to the presence of a gravitational field, which is predicted by relativity, occurs also in Dr. Rosen's variation. However, the predicted shift is only half as great as that calculated by Professor Einstein. The red shift due to gravitation should not be confused with the so-called Doppler red shift caused by motions of a source of light (a star) away from the observer. Gravitational red shift is caused by having the source of light in a different gravitational field than is the observer.

Although the gravitational red shift would not work over such short distances, it is like saying that the color of a green light on the top of the Empire State Building

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is a little more reddish to an observer at street level than it is to an observer at the observation tower on top of this skyscraper because the gravitational field is different for the two points of observation.

Dr. Rosen hopes next to apply his new theory to studies of the nucleus and to see if he can not calculate something about the nature of the basic forces within the atoms which hold their nuclei together and which constitute a sort of "cement" that helps hold matter together.—ROBERT D. POTTER.

MAPPING THE PORE PATTERN OF THE HUMAN SKIN

A NEW method of mapping the pore pattern of the human skin, which may some day supplement present fingerprinting methods in establishing human identity, was described at the meetings in New York of the American Physical Society by Dr. Harold A. Abramson, New York physician specializing in biophysics.

When methylene blue is applied to the skin by electrical current the whole area soon turns blue. But if the surface of the skin is rubbed thoroughly, all the color comes off except at the places where pores of the sweat glands show. Thus tiny blue dots show up under a microscope at any places where sweat glands are present, virtually over the entire body.

The significant point, although Dr. Abramson did not describe it at the meeting, and mentioned only the physics of the phenomenon, is that the patterns of the sweat glands from every individual are characteristically different in the same way that fingerprints are characteristically unique. In fact, a close examination of fingerprints shows that along each ridge are pores and that the fingerprints are merely the readily visible patterns of the pores in a particular spot on the body.

Explaining the phenomenon, Dr. Abramson pointed out that electrical currents can carry drugs and dyes into the skin by a process known as electrophoresis. Using dyes like methylene blue, it has now been learned that it is through the pores of the sweat glands that this passage occurs. Previously it was not known whether it was the hair follicles, the skin as a whole or the pores which transmitted the materials electrically.

Drugs like cocaine, novocaine and histamine have long been known to have the ability to penetrate the skin without breaking the skin by injection. The new method of making the pore pattern show up on any part of the body will give new "maps" for every individual that are much more comprehensive than present fingerprints. Human identification in accidents where fingerprints may be obliterated is only one possible application.

Another drug which Dr. Abramson has been able to make penetrate into the body through the skin by electrical action is sodium prontosil, a drug with many of the beneficial aspects of sulfanilamide. Whether the new method will be used in the treatment of infectious diseases for which sodium prontosil is helpful has not yet been studied, but the possibility exists.—ROBERT D. POTTER.

GROWING OLD

THE phrase "growing old" is in part just another way of saying that the capacity of the body to accumulate lactic acid in exercise is lessened, it was indicated in an address before the Northeastern Section of the American Chemical Society by Dr. David Bruce Dill, of the Fatigue Laboratory of Harvard University. Lactic acid is the fuel for muscular contraction, Dr. Dill explained, and the inability to store it as one grows older explains why an old man is unable to sprint 100 yards, although he may be able to walk all day long as well as he could when he was younger. "A man of seventy years may have one half the capacity for carrying on work in a steady state which he had in his prime, but his capacity for anaerobic work (work carried on after supply of free oxygen in blood is depleted) is almost lost. Lactic acid is sometimes spoken of as a fatigue substance that should be eliminated as rapidly as possible, Dr. Dill said. This is not a sound view. Lactic acid is a normal intermediate in the metabolism of carbohydrate and is available as fuel for muscular contraction. In fact lactic acid appears to be the fuel preferred by the heart. Although scientific research has debunked many of the old beliefs about the influence of weather on health, it is clearly not all superstition for man to attribute many of his ills to weather and climate. The time in the marathon is apt to be slow on a hot day and fast on a day considered chilly by spectators. Cold climates favor hard work and hot climates reduce the capacity for exercise of long duration. Many diseases, like pneumonia, are found to vary with the seasons, becoming more prevalent in the winter months.

THE UPPER CAVE OF CHOUKOUTIEN

THE now world-famous caves and clefts of Choukoutien housed not only the very ancient Sinanthropus population but also, though separately in a cave located on top of the hill—known as the "Upper Cave"—quite a different population who lived there at a much later period. This Upper Cave was discovered in 1930 and excavated systematically in 1933 under the supervision of Dr. W. C. Pei, but the results have only now been worked out.

The population of the Upper Cave already represents modern mankind. In accordance with their physical appearance they were the bearers of a relatively advanced culture, as is evident from the discovery of stone implements, a bone needle, a bone implement and necklaces or other ornaments made from beads of perforated teeth, shells, worked stones, fish and bird bones.

The fauna in the cave, composed of thousands of animal skeletons, conforms to the physique and culture of the man under discussion. Bear, hyena and ostrich found there have become entirely extinct since, whereas the tiger and hunting leopard have disappeared completely from this part of China and Asia.

All these facts indicate that the period during which the Upper Cave population lived corresponds to the Late or Upper Palaeolithic time of Europe, determined as the Aurignacian, Solutrean, Magdalenian, implying approximately 100,000 to 20,000 years ago. For the first time, representatives of an Upper Palaeolithic population have been discovered to occur on the soil of Asia, outside of Palestine.

The Upper Cave population possibly consisted of one family only: an old man, a younger man of indeterminable

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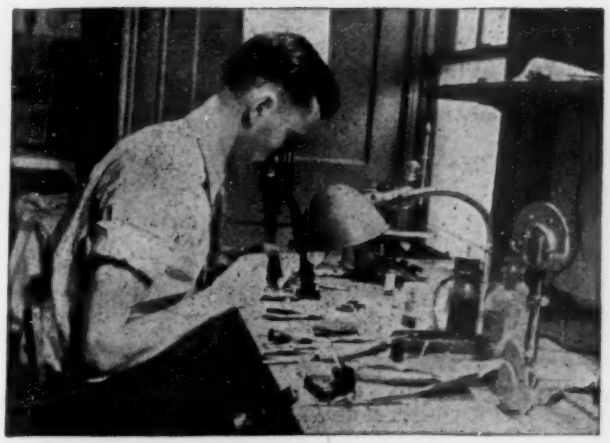

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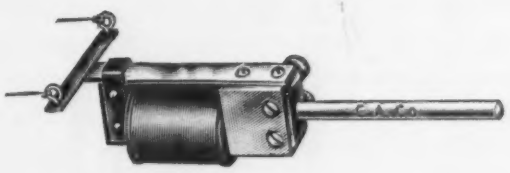

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age, two relatively young women, an adolescent, a child of five years and a newborn baby—perhaps even a fetus. The condition of the preserved skulls proves that all of them were killed by heavy blows with pointed and blunt weapons, possibly while being attacked by hostile tribes.

Three of the skulls, however, are sufficiently well preserved as to permit a determination of their special character. Though all three show certain features of the face in common, nevertheless they differ in others, thus giving the impression that they belong to three different racial groups. One of the women looks like a modern Melanesian of New Guinea, the other like an Eskimo.

The old man is of special interest in several respects. According to the form of his braincase he has to be considered a very primitive type, not too far removed from the stage of the Neanderthal Man. Again in other features he recalls the European Man of the Upper Palaeolithic, whereas the face points more to recent Mongolian types, though not actually identical with any one of them.

The skull of the Melanesian-like woman also shows a deformed forehead such as is found in consequence of artificial deformation among American Indians and other Eastern people of later times.

FRANZ WEIDENREICH
W. C. PEI

THE REFUGEE PHYSICIAN PROBLEM

THE American Medical Association has been asked to establish a special committee to aid the refugee physician. The request has come from six distinguished leaders of American medicine: Drs. David L. Edsall and George R. Minot, of Boston; John A. Hartwell, of New York; Warfield T. Longcope, of Baltimore; Howard C. Naffziger, of San Francisco, and Dallas B. Phemister, of Chicago.

Thus far the only action taken by the House of Delegates of the American Medical Association has been a recommendation to the state boards of medical registration that citizenship be the requirement for license to practice. The right to regulate the practice of medicine rests with individual states.

Requesting American Medical Association cooperation with the Emergency Committee in Aid of Displaced Foreign Physicians, the National Coordinating Committee for Aid to Refugees and Emigrants Coming from Germany and the Boston Committee on Medical Emigrés, the six physicians point out that "in the field of general practice and in the specialties also numerous openings exist for which it is difficult to find qualified American physicians; for example, poorly paid full-time physicians and practices in rural communities."

The *Journal* of the association in commenting on the subject in its current issue writes that: "If any of the committees can undertake to make a survey to locate such openings, a certain number of refugees can be absorbed with a minimum amount of disturbance to the rights of American physicians. The chief difficulties that have arisen in this situation come from the fact that some of the refugees are poorly trained or of low ethical standing, that some find it difficult to adapt themselves to American ways in the practice of medicine, and that many tend to settle in large cities already overcrowded with physicians. Perhaps the difficulties of adaptation can be overcome by well-planned instruction. Only the coordinating committees already mentioned or groups of a similar character can aid in solving properly the problem of suitable distribution of refugees to places where they may be useful rather than a foreign body setting up irritation and forcing extrusion."

ITEMS

A "WALLS OF GLASS" building dedicated exclusively to the fight against disease *via* the medical research route will be erected in San Francisco by Stanford University. A gift of Mrs. Louis Stern, of Palo Alto, it will become a unit of the Stanford University School of Medicine. Unusual cantilever design eliminates columns in the outer walls and allows use of large glass panels admitting sunshine.

A NEW and superior method for determining the number of coats of paint on a surface is announced by the National Bureau of Standards. A two-inch square area is abraded off the surface until the basic surface is reached. The boundary lines between distinct coats of paint or lacquer show up as distinct lines looking like isobars (lines of equal pressure) on a weather map, or like the contour lines on a geographical map. A previous method was the examination of a small section at the edge of the paint film with a microscope. It was slower and less certain.

A NEW use for a microphone and electrical circuit, which makes the roar of a grinding mill regulate the flow of material into the mill, was described at a recent meeting of the American Institute of Mining and Metallurgical Engineers. The device, known as an electric ear, makes the minerals feed into the crusher mill more rapidly if the mill is making too much noise. And if the mill is running too silently the device knows that it is feeding too rapidly and shuts down the intake of uncrushed materials. Just enough material is provided, at all times, to give the highest efficiency. The control of mill operations by the sound produced was described by Harlowe Hardinge, of the Hardinge Company, York, Pa.

W. L. BOND, an American who is operations manager of the China National Aviation Company, states that he has been advised by cable that his airline has been granted permission to operate a service between Kunming, capital of the province of Yunnan in southwestern China, and Rangoon, Burma. The airline, which will generally parallel the new highway linking the two cities, will cover some of the world's least known and most difficult territory. The aviation company, which serves the principal cities still under Chinese control, is owned jointly by the Chinese Government and Pan-American Airways, but Panair stepped out of the management upon the outbreak of war. Mr. Bond is in the United States on vacation.

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APPLETON-CENTURY, D., COMPANY, New York. *Spring Books, 1939.* Pp. 78.

BURKE AND JAMES, INCORPORATED, Chicago. *The Story of Korelle Reflex with Instructions and Operating Hints for Securing Perfect Photographic Results.* Pp. 12. Illustrated.

CENTRAL SCIENTIFIC COMPANY, Chicago. *Cenco News Chats, No. 22, February, 1939.* Pp. 22. Illustrated.

DU PONT de NEMOURS, E. I. AND COMPANY, INCORPORATED, Wilmington. *The Neoprene Note Book, Vol. 2, No. 11, January, 1939; Facts About Neoprene for the Engineer.* Pp. 6. Illustrated.

ELECTRICAL TESTING LABORATORIES, New York. *Current Notes; Special Number for General Circulation, December, 1938, No. 85.* Pp. 16. Illustrated.

FIEDLER, HENRY GEORGE, New York. *Catalogue No. 71, 1939; Books and Periodicals on Zoology (Embryology, Anatomy, Physiology, Evolution, Heredity).* Pp. 56.

HOUGHTON MIFFLIN COMPANY, Boston. *Spring Books, 1939.* Pp. 30.

LEITZ, E., INCORPORATED, New York. *Leica Photography; Vol. VIII, No. II, February, 1939.* Pp. 26. Illustrated. $0.10.

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SCIENCE NEWS

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YOUNG AND OLD STARS

THE sun is young and the brilliant, dense white dwarf star Sirius B is old among the stellar bodies, it appears from a report made to the American Physical Society by Dr. R. E. Marshak and Professor Hans A. Bethe, of Cornell University.

Sirius B is the relatively tiny star whose diameter is only 20,000 miles. Yet it is as massive as the sun, whose diameter is about 1,000,000 miles. Sirius B is 20,000 times as dense as the sun.

The dense, dwarf star consists of a gaseous envelope whose density is only slightly larger than that of the sun and a very dense core. The boundary temperature (between the envelope and the core) of Sirius B has been calculated at 8,000,000 degrees Centigrade. Previous calculations suggested that this boundary temperature was as high as 60,000,000 degrees.

Dr. Marshak and Professor Bethe, in new calculations, find that there can be only a very small amount of hydrogen present in Sirius B. It is the gas hydrogen which is now believed to be the "fuel" which most stars burn to create their enormous outpourings of radiation.

At the high temperatures and densities of Sirius B the radiation would be enormous if the dwarf star contained as much hydrogen as the sun. Therefore it is concluded that Sirius B contains less than one thousandth of one per cent. of hydrogen.

In the case of Sirius B it seems that the star has reached a stage wherein the high temperature and observed brilliance is caused mainly by gravitational contraction of the star.

PARTICLES OF URANIUM ATOMS

THE explosion of uranium atoms, with the release of enormous amounts of atomic energy and the production of two "splitter" particles which are probably barium and krypton, occurs over a volume of space about an inch in radius, it is shown in experiments reported in *The Physical Review*.

Dr. Edwin McMillan, of the radiation laboratory of the University of California, describes studies which indicate that the splitter particles cast off by uranium in its new-found explosion and break-up have a "range" of 2.2 centimeters or nearly an inch.

The splitting of uranium by impact with neutrons (neutral atomic particles) is thought to be the most important discovery in physics since radium and radioactivity were found at the turn of the century.

In another report credited to nine investigators at Columbia University estimates were given of the effective cross section of the neutrons which produce such uranium splitting. This cross section, for slow or thermal neutrons, is given as 2×10^{-24} square centimeters or .000,000,000,000,000,000,000,002 square centimeters. These slow neutrons have been found to be especially efficient in splitting uranium. Fast neutrons, found alone to be able to split thorium, are even smaller by a factor of 20 times.

From the Department of Terrestrial Magnetism of the Carnegie Institution of Washington was the report of Drs. R. B. Roberts, R. C. Meyer and P. Wang that the uranium splitting not only gave off energy and two particles but also released a neutron. Potentially this neutron could strike a near-by uranium atom and perpetuate the release of atomic energy.

ATOMIC DISINTEGRATION

FOR the first time anywhere investigators at the University of Notre Dame have demonstrated that an electron —lightest of all atomic particles—can produce an atomic disintegration.

Professor George B. Collins, Dr. Bernard Waldman and William R. Polye, of the department of physics, have shot swift flying electrons from the atom smasher into atoms of the chemical element beryllium. Out of the impact each beryllium atom, of mass nine, was turned into two atoms of helium, each with mass four, and into a neutron of mass one. The energies of the electrons used as "bullets" in the research were 1,720,000 electron volts.

The experiments are highly important to science because they indicate another way in which neutrons can be created by atomic bombardment. Neutrons are the massive, neutral particles used so widely in the current splitting of uranium with the release of vast amounts of atomic energy.

Previously investigators have been unable to effect transmutation of the elements and atomic disintegration with electrons. Cores of hydrogen atoms, known as protons, deuterons and neutral particles, the neutrons, have been employed.

Professor Eugene Guth, of Notre Dame, made the mathematical calculations forecasting that high energy electrons might disintegrate beryllium in a way which these experiments have now confirmed.

The actual train of events in the bombardment, according to Professor Guth, is that beryllium of mass nine when struck by the electron, forms beryllium of mass eight, plus a neutron, plus a low energy electron. The beryllium, mass eight, almost instantly breaks down into two helium atoms, each with atomic mass four.

THE X-RAY MACHINE IN THE TREATMENT OF CANCER

CHIEF weapon against cancer in the future, so far as treatment is concerned, will be a new 600,000-volt x-ray machine which, unlike the 1,000,000-volt machines, can be handled by the private physician and small hospital and which will replace radium in treatment of cancer except in a few types of cases.

This prediction is made on the basis of a statement by Dr. Francis Carter Wood, director of the Institute of Cancer Research at Columbia University, in his twenty-fifth annual report to the president of Columbia University.

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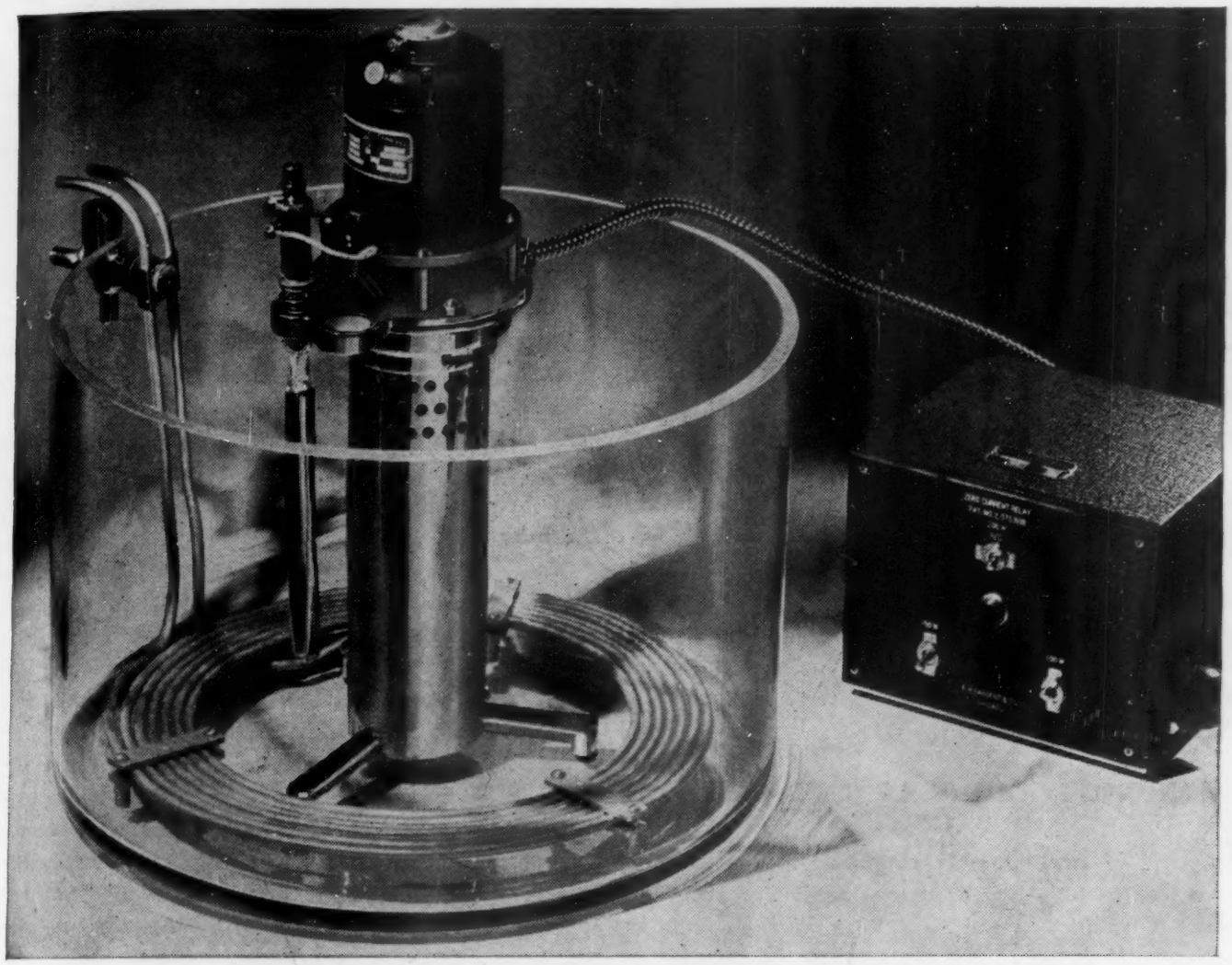

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million-volt x-ray machine is out of reach of the individual physician and the small hospital, to whom most cancer patients must turn for treatment. The question is, therefore, what is the lowest voltage that gives as good results in treating deep-seated cancer as a million-volt x-ray.

Experiments at the Crocker Institute have shown that x-ray at 200,000 volts is not as satisfactory as higher rates, but that it is altogether unnecessary to go above 700,000 volts and that even 600,000 volts is practically nearly as good as a million.

Dr. Wood believes that the electrical engineering of x-ray apparatus has reached such a point that it should be possible in a very short time to put on the market a machine giving off 600,000 volts which could be handled by a physician and that this, for a long time, will be all that is necessary for the treatment of cancer with this type of radiation. It will, with but few exceptions, replace radium in the treatment of cancer.

Radium, or perhaps some artificially radioactive substance, it was pointed out, will always be used for the treatment of tumors where it can be inserted into the growth itself, thus causing destruction without having any of the radiation pass through the skin.

THE MICROVIVARIUM AT THE WORLD'S FAIR

THE world in a water drop, magnified so that minute microbes look as big—and as lively—as jackrabbits, will be shown to visitors at the New York World's Fair in the microvivarium, of which Dr. George Roemmert, of New York, is the inventor. It will be housed in the Westinghouse building.

This instrument is a combination of microscope and projection lantern. Powerful beams of light, projected through trains of lenses, project the images of living one-celled plants and animals on screens so that the audience can see the intense dramas of their little lives plainly and on the largest scale. Dr. Roemmert will have twelve of these projectors in operation at once, so that the show will be large and varied. A microvivarium of an earlier model was one of the successes of the Chicago Century of Progress.

Among the manifold scenes of life in the usually invisible world is a display of the mating of the slipper animalcule, or paramecium. This is something that not even scientists had been able to demonstrate until recently. Usually the paramecium reproduces by simply dividing in two, each half then swimming off and rapidly growing to full size. But in this microscopic romance two individuals swim alongside of each other for a while, and then simply coalesce. It is literally a case of one plus one equals one.

Other tiny animals shown in the microvivarium are shaped like tiny bells, that stand bottom side up at the end of long, slender stalks. A fine muscle-like fiber runs down through each stalk, so that when the little animal feels danger near, or just wants to for any other reason, it pulls itself down like a flash by contracting the usually straight stalk into a tight spiral like a coiled spring.

The microvivarium is also used to show the details of the inner lives of some of the smaller many-celled animals, particularly minute worms, insect larvae and microscopic relatives of crabs and crayfish. It shows, for example, the writhings of vinegar worms, the swallowing movements and heartbeats of a mosquito larva and the unborn young in the brood-pouch of the minute crustacean known as the water-flea.

THE METCALF BLIND LANDING SYSTEM FOR AIRPLANES

PERFECTION of a virtually fool-proof blind landing system for airplanes seems assured within the next year or two, following successful tests at East Boston Airport of major elements in a new radio-beam method developed by investigators at the Massachusetts Institute of Technology and by Irving R. Metcalf, of the Civil Aeronautics Authority.

Radio micro-waves only seventeen inches long, the shortest ever applied to aeronautical radio, provide a straight, static-free path down which an airplane can make a normal "straight" landing glide to land in the middle of the runway, no matter how thick the weather outside the cockpit. The plane is in proper position for a landing at all times during the glide.

There is only one instrument for the pilot to watch, and it may be used to simplify regular instrument flying as well. The apparatus, when finally assembled, will be extremely light. It is the first blind landing system whose principle—the straight glide path—meets the requirements of Army fliers.

Actual flying tests were conducted recently in a small plane owned by the Civil Aeronautics Authority which proved that a "spotlight" beam of extremely high frequency radio waves can be used effectively as part of a trail blazer for airplanes trapped in fog.

Three lighted dots in a cathode ray tube instrument in the pilot's dash board tell him whether he is on course or if he is not, in what way his position is wrong. When the three lights are lined up horizontally, with the middle dot properly centered, the plane is on course.

The plane's gyroscopes, indicating bank and climb, control movements of the outer lights. The center light is controlled by four overlapping "spotlight" beams of radio micro-waves. When the plane follows the straight glide path—the area in which the four beams meet—the signals of the separate radio beams will be equalized, and the center light will remain on center. If the plane rises or falls, or moves to left or right of the path, the relative signal strength of one of the beams will increase, and the spot will be deflected in that direction.

The Metcalf-Massachusetts Institute of Technology system has other advantages as well as inherent simplicity. The signals are not reflected from the ground and hence are independent of ground conditions. Because the instrument follows the relative strengths of four signals sent out by the same transmitter, the absolute volume of the four signals makes no difference. This is not true of previous blind landing systems, which have required cumbersome, sensitive apparatus to overcome this difficulty.

Originally suggested by Mr. Metcalf, the system's development has been made possible by the cooperation of Professors Edward L. Bowles, W. L. Barrow, W. M. Hall and Charles S. Draper. Army, Stanford University and Sperry Gyroscope Company experts have also cooperated.

The basic idea was first used by Mr. Metcalf in guiding a landing by three visible lights on the ground. One light was at ground level, at the center of the runway. Two other lights were placed on either side of the runway, at an appropriate height from the ground. If the pilot lined up the three light in a row, he made a good landing. Pilots made scores of semi-blind landings with this system, observing the lights through a ground glass screen.

The straight glide path is superior to the curved path provided by earlier systems using radio waves reflected from the ground. In following a curved glide path, the pilot must often change his angle of descent. Moreover, the curve flattens out toward the ground. Just as the plane is closest to making an actual landing, therefore, it is moving forward much faster than at the top of the glide.

A RUSSIAN NON-MAGNETIC SHIP FOR RESEARCH TRIPS

THE Soviet Government is planning a non-magnetic ship for research on variations in the earth's magnetic field in the Arctic regions, according to *The United Services Review*, British military and naval journal.

Because of the sensitiveness to near-by iron masses of the instruments used in magnetic survey work, it is necessary to build research ships intended for this purpose out of wood, with bronze, aluminum and other non-magnetic metals substituted for iron wherever possible.

The new Soviet vessel is planned to be of 700 to 800 tons displacement, yacht rigged, with an auxiliary engine.

Plans under discussion also include carrying an airplane, on which the *Review* comments, "How the metal difficulty will be overcome has not been fully explained."

In the meantime, the new British non-magnetic ship, *Research*, is nearly ready for duty, and a search is being made for officers and seamen experienced in handling sailing ships. In this steam-and-motor-dominated age, sailors who can readily sail are not as numerous as they used to be.

ITEMS

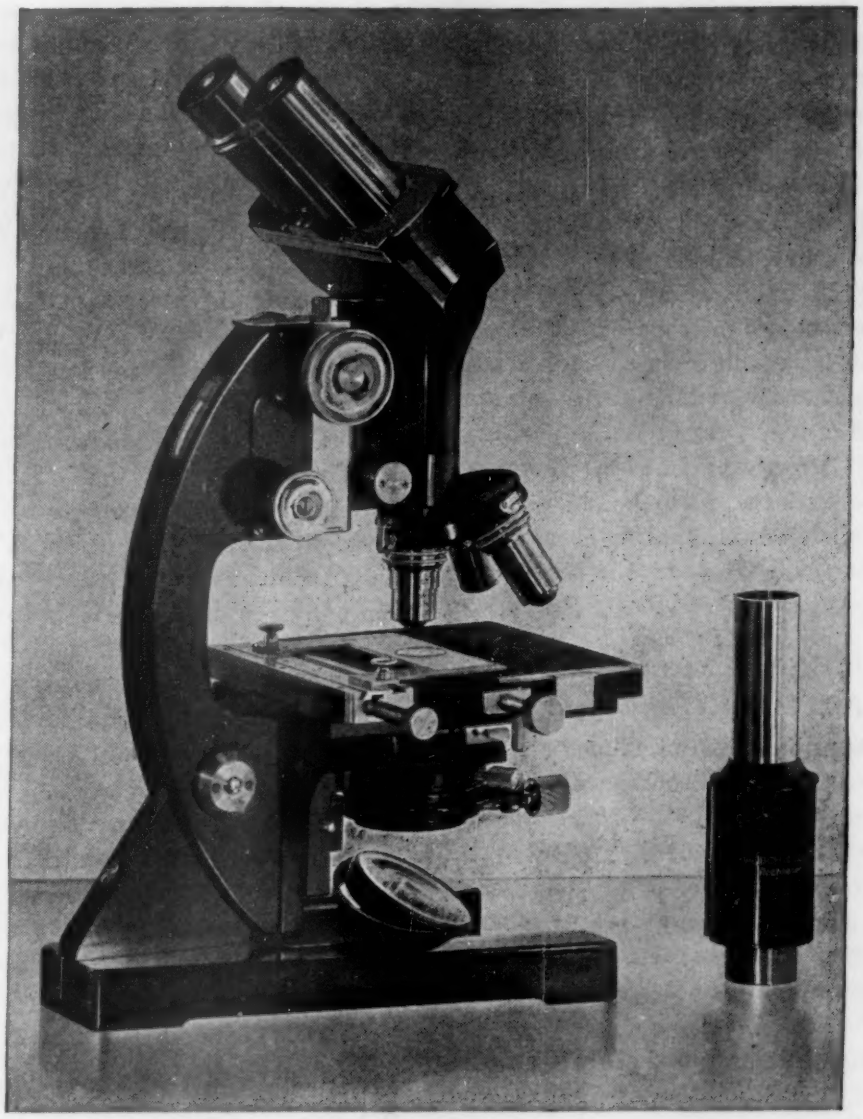
WHEN really heavy rain falls in California, that's "unusual." But when enough rain falls to make a lake in Death Valley, that's news. And that's what has happened, U. S. National Park Service observers report from the famous desert valley. The Armagosa River, usually nothing but a dry wash, has overflowed its banks and spread out into a lake dozens of square miles in extent. Death Valley is not completely rainless, even in "usual" years. Its annual precipitation averages a trifle under an inch and a half. Even this little is enough to carpet the earth with flowers for a short time in the spring. This year, because of the heavy rains, the spring wildflower show is expected to be even finer than usual.

THE ear trouble which is the "most common subjective complaint of both airplane pilots and passengers" can be relieved or prevented by inhalations of helium and oxygen, Drs. W. R. Lovelace, II, C. W. Mayo and W. M. Boothby, of the Mayo Foundation, have found. They suggest inhalations of these two gases whenever possible during periods when marked changes in elevation of the plane are occurring, especially when descending for landings. This is especially important for persons who have difficulty in opening their eustachian tubes voluntarily as by swallowing or yawning.

INTERSTELLAR space is almost synonymous with the ultimate in emptiness but actually there is so much matter in space that the stars of the Milky Way would seem twice as bright as they do now if the "dust" were eliminated. "Since the effect of interstellar dust is to make objects look fainter than they otherwise would, the estimates of distance for faint stars have been too great," Dr. Joel Stebbins, director of the Washburn Observatory of the University of Wisconsin and research associate of the Carnegie Institution, said in an address recently. "The overall diameter of the galaxy, or system of stars of which our sun is a member, is probably about 100,000 light years instead of the 200,000 light years which was inferred without allowance for the absorption of light in space." A light year is an astronomical unit equal to the distance light would travel in a year at a speed of 186,000 miles a second. A light year amounts to 6,580,000,000,000 miles. Dr. Stebbins, with his colleague, Dr. A. E. Whitford, has for the past decade been studying the heavens by using photoelectric cells. These cells catch faint light rays and observe regions of space which appear dark and which can not be observed for useful astronomical studies either by telescopes or by photography.

A NEW type, cubic-shaped antenna for the 10-kilowatt television station of the General Electric Company atop a 1,500-foot mountain in the Helderberg hills region near Schenectady, N. Y., is nearing completion. Radical both in shape and design, the antenna will radiate picture-carrying waves polarized horizontally so that the signal will have more power than any existing television station in America. Using four and one half meter waves, the station, W2XB, will blanket the region of Albany and the entire capital district of New York State. Expected range of the station is about 40 miles, the distance to the horizon.

AIRLINE operation at higher altitudes during recent years—between 4,000 and 10,000 feet—has cut the number of air-sick passengers to three out of every thousand, a study announced by Colonel A. D. Tuttle, United Air Lines medical director, revealed. Records of 261,370 passengers carried on the line during the past year showed that only .59 per cent., or six out of every thousand, suffered physical discomfort during the flight. Air-sickness is less frequent than sea-sickness. Cases of ear trouble, caused by pressure changes as the plane climbed or descended, numbered but five hundredths of one per cent., or, 141 passengers in all. Colonel Tuttle attributed the low figure for air-sickness at higher altitudes to the greater smoothness of the air. Five years ago, airline publicity people estimated the percentage of air-sick passengers approached three or four per cent.



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This book is a revision of the first half of the authors' *Methods in Plant Physiology.* In the present volume the experiments have been simplified to adapt them more closely to undergraduate use and particular care has been taken to make all directions clear and unambiguous. New material on the relation of growth hormones to plant development has been added.

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SCIENCE NEWS

Science Service, Washington, D. C.

COSMIC RAY RESEARCH

COSMIC RAYS, already a potent means of learning new things about the nuclei or "hearts" of atoms, will next have the task of helping scientists discover new facts about distant nebulae. This new rôle of cosmic ray research in the future was suggested at the Sigma Xi lecture at Louisiana State University by Professor Carl D. Anderson, of the California Institute of Technology.

Dr. Anderson, Nobel Prize Laureate in Physics in 1936, when he was only 31 years old, is known for his researches on cosmic rays and for his discovery of the positron, fundamental atomic particle. In his lecture he said: "Cosmic ray researches have told us new facts about the smallest things in the universe, the elementary particles. They give rich promise of telling us in the near future equally important facts about the largest things in the universe, about the far-away nebulae and other astronomical bodies. Cosmic ray investigations will support and be supported by astronomical investigations. The electroscope, Geiger counter and cloud chamber will work hand in hand with the 200-inch telescope, each doing an important job in translating into knowledge those messages which come to us from outer space."

The energies of some cosmic ray particles are enormous, he continued. They are more than 1,000 times as energetic as any other particles known in the science of physics. In studying cosmic rays in the laboratory scientists are in effect "sitting in" at the death and birth of matter. A certain electron, for example, which may have been playing its prosaic rôle as a part of an atom for hundreds or thousands of years, will be struck a blow so hard that it will be projected through space at a speed greater than a hundred thousand miles a second; it will in turn strike several million other electrons and pass through several million atoms before it is finally brought to rest and again attaches itself to another atom, where it may carry out its normal duties with very little disturbance for perhaps another million years.

Other electrons, however, may be annihilated by the cosmic ray impact. After several million years' existence, perhaps, suddenly this electron disappears. But out of this annihilation a new electron appears which is one of a set of atomic "twins." These twins are alike except that they have opposite electrical charges.

Such positive and negative electrons, created in pairs, follow a greatly different "life" pattern. The negative electron joins other similar electrons and takes up a normal existence in some other atom.

The positive electron, however, survives only for about a billionth of a second. In this brief fraction of time the positron electron finds a negative electron and the two combine and neutralize their electrical charges. By this union they are annihilated and in their stead appear "two bits of radiant energy whose ultimate fate will be to interact with other electrons in the surrounding material."

This was the first of fourteen lectures which Dr. Anderson will give in universities through the country during the next three weeks. The lectureship is sponsored by Sigma Xi, national honorary society for the promotion of research in science. Election to membership in Sigma Xi is equivalent—among scientists—to membership in Phi Beta Kappa in general academic life.

NEW 82-INCH TELESCOPE OF THE McDONALD OBSERVATORY

THE new giant among telescopes, the 82-inch mirror of new McDonald Observatory, has been given its baptism of starlight and proved to be practically perfect in mirror quality and operation. For a number of nights the new telescope has been in use.

"Every new observation will mean an addition to our knowledge of the universe," said Dr. Otto Struve, director of both Yerkes and McDonald Observatories, after the preliminary observations.

The telescope was first pointed at a star on March 2. When brought to a focus the star image was steady and sharp, showing that the mirror was practically perfect. Photographs of brighter stars and of the moon were then obtained at the Cassegrain focus of the instrument. The first star of which the spectrum was photographed was the fifth magnitude object, 17 Lepocis, located south of Orion. This spectrum shows many features never before recorded with any instrument.

The McMath type electric drive controls the telescope so accurately that once adjusted for an observation the astronomer does not need to stay at the eyepiece to guide the telescope. The astronomer at the telescope moves it into position by push-button controls.

Since all mirrors of the 82-inch telescope are coated with aluminum, observations in the ultra-violet region of the light spectrum will be particularly efficient. Most of the old telescopes are designed in such a way that the ultra-violet light is lost, even when the conventional silver mirror coating is replaced by aluminum with its superior reflecting power in the ultra-violet.

The group of astronomers who made the tests included Dr. Struve, Professor George Van Biesbroeck, Professor Gerard P. Kuiper and Professor C. T. Elvey, of the joint Yerkes-McDonald Observatory staffs, as well as Dr. J. S. Plaskett, of the Dominion Astrophysical Observatory at Victoria.

McDonald Observatory was built by the University of Texas and is operated jointly by that university and Yerkes Observatory of the University of Chicago.

MEASUREMENTS OF THE TEMPERATURE OF TREES

TREES have thermostatic methods of their own for resisting both freezing in winter and overheating in summer, Professor E. S. Reynolds, plant physiologist of Washington University and of the Missouri Botanical Garden, has discovered in measurements of tree-trunk and air temperatures over a period of four years.

Professor Reynolds inserted automatic, recording, elec

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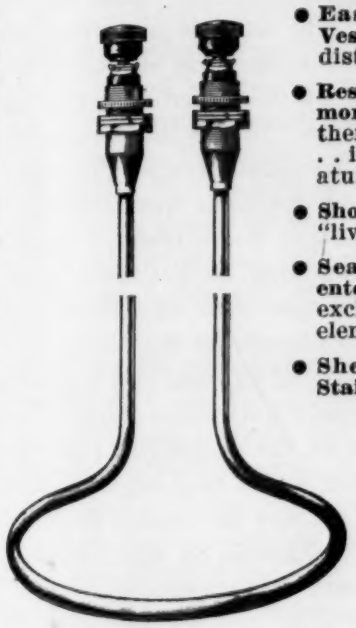

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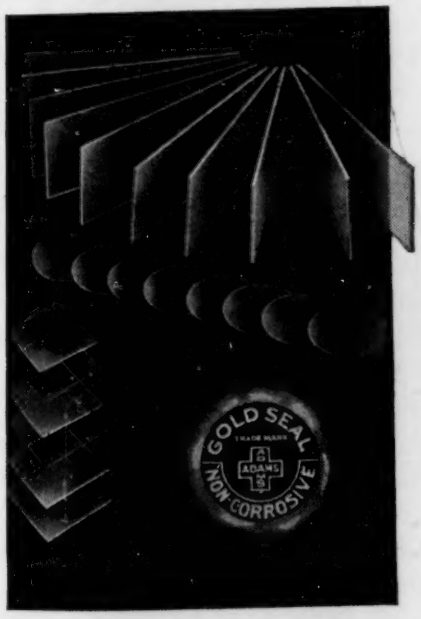

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trical resistance thermometers in the heart of a tree-trunk and in the cambium or growth layer just under the bark. He also used a similar, shaded instrument to record the air temperatures alongside of those of the trees.

In the winter period the tree temperatures changed more slowly than the air temperatures. The lag became especially pronounced just when the temperature reached the freezing point. Often for a period of 24 to 60 hours after the air temperature had dropped several degrees below the freezing point the tree temperatures remained steadily at about the freezing point.

Likewise when the air temperature rose well above the freezing point the tree temperature would not pass about this point for a long time.

However, once this point was passed in either direction the temperature of the trunk followed that of the air rather closely. Dr. Reynolds regards this more or less extended period of steady temperature at the freezing point as dependent upon the release of heat during the freezing of the water in the tree and the equivalent absorption of heat later in the process of melting the ice.

Resistance to extreme temperatures in summer followed a different pattern. Thus under these conditions the temperature at the center of the tree dropped to 60 to 63 degrees and the cambium was less than 90, when the air temperature was above 105. The tree's ability to keep its trunk cooler than the torrid surrounding air seems to be tied up with two factors. The air spaces in the wood can hold larger quantities of water vapor as the temperature rises and more spaces are developed in the finely tubular tissues of the wood. This latter occurs because of the breaking of the slender sap columns due to the severe pull exercised on them by the rapidly transpiring leaves. From the near-by wet tissues water is evaporated rapidly into these nearly empty spaces until they are saturated with water vapor. The great amount of heat that is required to evaporate water is one of the best known physical phenomena. The tree thus keeps itself cool, at all times when it is in good foliage, by the absorption of heat from the tissues by this evaporation as if from a kind of internal sweat.

When it is remembered that the tender, growing cambium zone is not far beneath the surface of the bark, which is often heated to high temperatures by direct sunshine, the value of this cooling process is more evident.

Professor Reynolds also points out that his studies raise anew the old question of the possible rise of water in trees in the form of vapor. This was once one of the most-discussed of plant physiological theories, but has been more or less in abeyance lately. However, if water vapor is a regular part of the tree's temperature regulating mechanism, there is at least a possibility that it is also transported upwards, to be condensed back into liquid in leaves or twigs.

ALUMINUM DUST INHALATIONS AND SILICOSIS REMEDY

THE possibility that aluminum dust inhalations may serve both as preventive and remedy in silicosis appears in the report to the *Journal* of the Canadian Medical Association of J. J. Denny, metallurgical engineer, Dr. W. D. Robson, chief surgeon of the McIntyre Porcupine Mine, Schumacher, Ont., and Dr. D. A. Irwin, of the University of Toronto.

Silicosis is the lung disease resulting from inhalation of silica or quartz dust. The silicosis-preventive action of aluminum dust inhalations was first suggested in research on rabbits reported by the Canadian investigators to the academy two years ago. In this latest report their findings of two years ago are substantiated. The manner in which aluminum powder prevents quartz dust from damaging the lungs is explained, and it is shown that some quartz dust already inhaled may be gradually removed from the lungs under treatment with aluminum powder.

The development of the fibrosis of the tissues in the lungs, which is characteristic of silicosis and is produced by the inhalation of extremely fine quartz dust, is known to be due to the poisoning of the phagocytic (scavenger) tissue cells by the silica dust which they engulf. Because they are poisoned and killed, they are unable to eliminate this dust through the usual channels by which inert dusts are eliminated. The present experiments show that the action of the aluminum is to prevent the silica from poisoning and killing the lung phagocytes, and thus allow them to carry away the silica just as they would an inert dust.

It seems that the fine aluminum powder is gradually dissolved by the body fluids in the form of a colloidal or jelly-like aluminum hydroxide, which is then adsorbed and firmly held upon the surfaces of the quartz particles, and seals these surfaces so firmly that the quartz can no longer go into solution and poison the body tissues. Since the aluminum and its hydroxide are themselves harmless and non-irritating, the result is that the quartz particles are also rendered harmless, and therefore placed in the way of being eliminated by natural processes.

Experiments showed that it was not necessary that the aluminum dust should be inhaled at the same time as the quartz dust. Rabbits that inhaled aluminum dust for 40 minutes each morning were completely protected, although they inhaled quartz for the next 12 hours. The only condition seems to be that the amount of aluminum dust deposited in the lungs should be at least about one per cent. of the weight of the quartz dust, and that this aluminum dust should be distributed fairly uniformly with the quartz dust, so that it can get at it and act upon it.

Perhaps the most interesting experiments, from the standpoint of the treatment of silicosis, were those which indicated that if rabbits which had already developed silicosis and whose lungs contained considerable quartz dust were allowed to inhale a little aluminum dust each day, the quartz dust was not only rendered inactive but was steadily removed by the lung phagocytes, so that it was carried out of the body, and the further progress of the disease might be expected to be prevented. One of the most characteristic and serious things about silicosis has been the fact that when the quartz dust has once been deposited in the lungs the irritating and poisoning action continues for years, and the patient gradually gets worse. These experiments give hope that by the inhala-

tion of aluminum much of this quartz dust may be removed, and the progress of the disease retarded or even stopped.

MARKETS FOR NEW ENGLAND'S HURRICANE-FELLED TIMBER

USES and markets for New England's timber blown down by last fall's hurricane will be at least partly determined in Wisconsin. Scientists and engineers at the U. S. Forest Products Laboratory are seeking outlets for logs salvaged from the wind-felled trees, now in government-leased storage ponds in the devastated area. Some of their conclusions are set forth by Carlile P. Winslow, director of the laboratory, in the new issue of *American Forests*.

Present rough estimates figure salvageable logs of six inches diameter and up at about two billion board feet. Of this, 300 million board feet is in hardwoods, the rest in softwoods, principally spruce and white pine. Hitherto, New England's timber needs have amounted to between 800 million and one billion board feet a year. Local sources have supplied only half of that amount; the rest was shipped in. Furthermore, near-by New York, New Jersey and Pennsylvania have an annual timber requirement of some four billion board feet. New England, however, has had practically no share in that great market, and would have to meet competition of lumber from other sources if an effort were made now to enter it.

In New England, itself, the normal hardwood demand, for furniture, millwork, spools and bobbins, woodenware, etc., can use up the 300 million board feet of hurricane hardwood lumber in about three years. This will mean, of course, that the region's usual purchases of outside hardwood will be somewhat diminished during that time, though they will by no means stop altogether.

Disposal of the huge quantities of white pine will not be so simple. A great deal of this used to be consumed in lumber for boxes and crates, but the depression has cut into this demand very severely, and substitute materials have also captured a considerable part of the market.

It is a long time since New England white pine was sawed into the sizes of lumber needed for house construction. Much of the white pine now available can be used for this purpose, although its knottiness will necessitate shaping into the old full-sized "two-by-fours" and other dimension timbers, instead of the skimped measurements now prevalent in the construction lumber trade.

Pulp for paper and rayon will be the outlet of a good deal of the down spruce and fir in the northern part of the hurricane's path. There is even a chance that some of it may be exported to Europe. Mr. Winslow states that favorable prices have been paid for American pulpwood by Central European purchasers.

Possible pulp uses for white pine and some of the hardwoods are being investigated at the Forest Products Laboratory. Special treatments will be necessary to pulp these woods successfully, but the effort is considered worth making.

ITEMS

A SUBSTITUTE for blood for transfusion to revive patients suffering from shock has been discovered by Drs. H. A. Davis and J. F. Blalock, Jr., of the University of Tennessee. Instead of blood, they have found, the fluid removed from patients suffering from abdominal dropsy or from pleurisy can be used. This fluid, called ascitic fluid, must be typed just as blood must be before use in transfusions. It is useful in cases of shock in which there is a concentration of red blood cells but a deficiency of the fluid portion of the blood. Storing the fluid in a refrigerator does not affect its usefulness. Technical details of investigations of this substance as a substitute for blood when the latter is not available have been reported to the *Journal of Clinical Investigation*.

A NEW motion-picture technique has enabled Harvard educational psychologists in eight weeks to improve by 50 per cent. the reading speed of a group of 16 college freshmen. The group increase in speed, averaged, was from 251 to 382 words per minute. In the short period the students improved fundamentally their habits of eye-movement in reading, for the first time exercising conscious control. The number of eye-fixations per line of reading was reduced from 10.8 to 6.5, and the average number of regressions in reading from two every three lines to one every two. The students also gained in reading accuracy.

Two National Advisory Committee for Aeronautics scientists at the National Advisory Committee for Aeronautics' Langley Memorial Aeronautical Laboratory have determined that injection of fuel directly into the cylinders of an aircraft engine produces the greatest output of power. Tests conducted on a single-cylinder experimental engine proved that the greatest amount of air and fuel can be put inside a cylinder by this means, as compared with manifold injection and carburetion.

LIGHT BLUE eggs are being laid by hens of a new hybrid type, produced in the poultry department of Cornell University. The hens are a cross between the ordinary white Leghorn and a South American fowl known as the Araucana hen, which lays deep blue eggs. When crossed with fowl that normally lay brown-shelled eggs, a hybrid is produced that lays eggs with olive-colored shells.

STRAWBERRY clover, a forage plant that loves wet soil and can tolerate relatively high concentrations of alkali, is recommended for use in seepy and alkaline fields by the Bureau of Reclamation, U. S. Department of the Interior. Tests during the past few years in the West have proved the plant to be of such merit that its general adoption is now encouraged. Strawberry clover is so named because it propagates itself, after it once gets a start from seed, by throwing out long runners that root at the tips, after the manner of a strawberry plant. Its botanical name, *Trifolium fragiferum*, is a reference to this resemblance: Frageria is the scientific name of the strawberry. This relatively new clover apparently came to the United States from Australia, in lots of mixed seed intended for pasture sowing. In some of the earlier plantings it has not only persisted after the grasses with which it was mixed, but has even driven out salt grass, foxtail and other weeds notorious for their aggressiveness.

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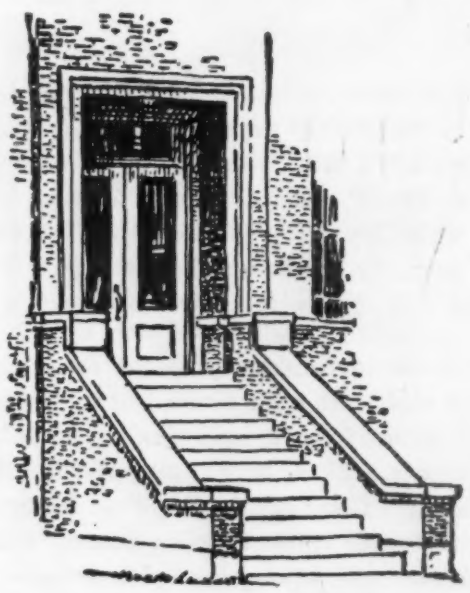

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SCIENCE NEWS

Science Service, Washington, D. C.

PROFESSOR EINSTEIN'S THEORY TO UNIFY GRAVITATION AND ELECTRICITY

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PROFESSOR ALBERT EINSTEIN has entered the *fifth* dimension in his mathematical calculations seeking to link gravitation and electricity into one unified field theory which would explain all physical happenings in one broad concept. Thus the man who puzzled millions of people when he introduced the fourth dimension in his famous theory of relativity has gone one step further.

Announcing on his recent sixtieth birthday that he was making progress in his long-sought goal of connecting the force of gravity with the electric fields which make possible such things as light and radio waves, Professor Einstein left undisclosed his method of attack on this toughest of all problems in mathematical physics. Securely buried in the technical literature of mathematics until now, may perhaps be found the hint of what Professor Einstein is now doing.

In the latest volume of the *Annals of Mathematics* is a complex paper by Professor Einstein and Peter G. Bergmann, assistant at the Institute for Advanced Study at Princeton, N. J., entitled "On a Generalization of Kaluza's Theory of Electricity."

Professor Theodor Kaluza, of the University of Göttingen, reports Professor Einstein's important paper, introduced the fifth dimension into conceptions relating gravitation and electricity but used this fifth dimension only as a mathematical idea without physical meaning. Professor Einstein's new approach ascribes a physical reality to this fifth dimension. But with this step the distinguished mathematician finds himself in a kind of space which is truly puzzling.

"There have been many attempts," reports the Einstein paper, "to retain the essential formal results obtained by Kaluza without sacrificing the four dimensional character of the physical space. This shows distinctly how vividly our physical intuition resists the introduction of the fifth dimension. But by considering and comparing all these attempts one must come to the conclusion that all these endeavors did not improve the situation. It seems impossible to formulate Kaluza's idea in a simple way without introducing the fifth dimension."

"We have, therefore, to take the fifth dimension seriously although we are not encouraged to do so by plain experience," explains Professor Einstein. Thus reluctantly, he states that he is entering into still more complex mathematical theories than his previous one.

In his five-dimensional theory, space is closed along a vector indicating the fifth coordinate. This, he says, is the essential difference between his new work and that of Professor Kaluza. "By making this change," Professor Einstein says, "the basic assumptions of the theory are considerably simplified. Furthermore it is much more satisfactory to introduce the fifth dimension not only formally, but to assign to it some physical meaning. Nevertheless there is no contradiction with the empirical four-dimensional character of physical space."

Like his previous theories, which have left strange concepts for the layman to grasp, the new Einstein five-dimensional word has its own paradoxes. For example, a single point P in physical space is represented by an infinity of points in the five-dimensional space. Ordinary space, as most people envision it, consists of the three dimensions of Euclidean space which we call height, breadth and thickness, in speaking about an object like a box. To these Professor Einstein linked time as a fourth dimension in his relativity theories.

The fifth dimension introduced now accounts for properties of the electro-magnetic field which previously have not appeared in relativity. Instead they were accounted for by other theories which had little apparent linkage with gravitation.

As would be expected, the new theory is enormously complex. For example, it is necessary to introduce a special coordinate system in which space is described by 14 different mathematical functions.

ROBERT D. POTTER

THE SPEED OF LIGHT

A HARVARD physicist has solved a three-century-old problem of science, how to measure automatically the fastest thing in the universe—the speed of light. The ultimate velocity of about 186,000 miles per second has been measured by Dr. Wilmer C. Anderson, research fellow, by crimping the light beam with "permanent waves," 19,200,000 of them per second.

This new light-speedometer is the first which has not required visual observation by the human eye, and which has eliminated friction as a possible source of error. It can measure light-velocity with an error of less than two and a half miles per second. It is believed that the apparatus will give the most accurate measurements of light-speed ever made.

The equipment has been put to work on one of the basic problems of modern physics and astronomy—whether the speed of light is actually constant under all conditions or whether it varies. Although many important theories are based on the assumption of a constant velocity of light, past measurements have been inconclusive on this point.

In contrast with the large scale of some types of light-speedometers, which have utilized long outdoor tubes, Dr. Anderson's apparatus is contained in a small laboratory room and hallway. Four separate readings of light-speed can be made per minute.

The beam of a 1000-watt projection lamp is passed through a tube which modulates the beam at a frequency of 19.2 megacycles—or in other words makes the beam fluctuate between bright and dim intensity 19,200,000 times a second. Accuracy of the fluctuations is controlled by a standard frequency generator developed by Professor G. W. Pierce, of Harvard.

With the light issuing from the modulator in waves of

known frequency, the main problem is to determine the exact length of the manufactured waves. Velocity is equal to the frequency multiplied by the wave-length. The fluctuating beam splits at a small sheet of glass held across the path. One side goes up and down a hallway system of mirrors a distance of about 185 yards. This long path is fixed, and its length is known to fifteen thousandths of an inch. The other half of the beam is sent over a shorter path, about two yards long, whose length is slowly varied during the velocity measurement. Each half of the beam has the same wave-form, or light to dark fluctuations, as the original. After traveling their different paths, the two halves of the light beam are recombined and focussed on a special photoelectric cell, a five-stage electron multiplier tube, which translates the light force into electric impulses whose intensity can be easily measured and recorded.

The basic clue to the wave-lengths comes from the intensity of the reunited light beam. The intensity depends entirely on the relation between the fluctuations of the two half-beams as they reunite. If the fluctuations coincide—that is, if the bright parts of one beam enter the photocell with the bright parts of the other beam, then the fluctuations of light intensity will be at their greatest. Conversely, if the two beams "cancel" one another—if the bright spots of one enter the cell with the dark spots of the other—then there will be a minimum fluctuation of the light intensity.

By altering the length of the short path slowly and constantly during the recording, by means of a moving mirror, Dr. Anderson is able to determine the exact point at which the light beams cancel one another. At that point it is known that the long-path beam is entering the photocell exactly 23 half-wave-lengths behind the short-path beam, or, in other words, that the long light-path is 23 half-wave-lengths longer than the short path. Since the lengths of the two paths in meters is very accurately known, determination of the wave-length of the light waves becomes a matter of simple mathematics. Dr. Anderson has spent three years perfecting the equipment, financed in part by the Carnegie Institution, Washington, D. C.

A NEW OPTICAL GLASS

A DISCOVERY which may be a major stride in the advance of photography and which permits lens makers to produce "faster" and better lenses has been made by Dr. George W. Morey, of the Geophysical Laboratory of the Carnegie Institution of Washington.

The discovery of a way to make optical glass out of rare chemical elements instead of common silica permits the production of a glass which has a very high index of refraction and a low dispersion, it is disclosed in a patent, No. 2,150,694, just granted to Dr. Morey. This means a lens which serves the photographer more efficiently. Some of the optical glasses of Dr. Morey have the highest index of refraction (light-bending power) ever reported; more than 2.00. Only comparable refraction is that of the diamond, which is about 2.41. The optical properties of glass used in lenses have long limited optical lens-makers in the exactness of the work they could produce. Dr. Morey's discovery of a new kind of glass should remove this present limitation.

Out of the work should come lenses of greater light-gathering power which would be a boon to all miniature camera fans who ever seek greater apertures. Moreover, high index of refraction and low dispersion permit better corrections for chromatic aberration, the annoying property of some lenses of bringing different colors to different focuses.

Chemical elements most people have never heard of are used in producing the glass. Yttrium, lanthanum, columbium, hafnium, tantalum, zirconium, strontium, boron and barium are typical. The aim of Dr. Morey is to produce a glass with an index of refraction (ability to bend light rays) of over 1.65. One glass, made of 60 per cent. lanthanum and 40 per cent. boron, has a refractive index of 1.72 and a dispersive index of 54.

Another composed of 33 per cent. lanthanum, 41 per cent. thorium and 26 per cent. boron has a refractive index of 1.76 and a dispersive index of 52. As a comparison, ordinary flint glass of a lower refractive index (1.65) would have a dispersion of about 33. Small dispersion numbers mean high dispersion and *vice versa*. The new work is a continuation of efforts made in America since the World War to produce better optical glass. At the time of the conflict, the United States found it had been buying most of its superior optical glass from Germany. Furious war-time research partially overcame the difficulty, but research has been going on ever since to make American optical glass equal or superior to any glass in the world. Dr. Morey's work is a contribution to this end. Patent rights to his discovery have been assigned to the Eastman Kodak Company.

ROBERT D. POTTER

THE EFFECTIVENESS OF SULFANILAMIDE

NEW evidence of sulfanilamide's effectiveness in pneumococcic pneumonia is presented by Drs. Alvin E. Price and Gordon B. Myers, of Detroit, in the forthcoming issue of the *Journal* of the American Medical Association.

The Detroit study is based on 115 cases of pneumococcic pneumonia. These were treated with uniform doses of sulfanilamide and alternated with 40 cases treated with Felton serum and 94 controls who received no specific therapy. For the entire sulfanilamide group, the death rate was 15.7 per cent.; for the controls, 30.8 per cent. The death rate for 57 patients with types I, II, V, VII and VIII pneumonia treated with sulfanilamide was 10.5 per cent., whereas it was 27.5 per cent. for the 40 patients treated with serum.

Some of the patients treated with sulfanilamide developed anemia.

Reported in the same journal were six new cases of pneumococcic meningitis treated with sulfanilamide and 344 cases of erysipelas treated with the new drug.

More than 30 cases of recovery from the deadly pneumococcic meningitis have now been reported. The death rate is not so high under sulfanilamide treatment as under other types of treatment, two Cincinnati phy-

sicians, Drs. Barbara A. Hewell and A. Graeme Mitchell, report in reviewing the literature.

Of the 344 cases of erysipelas treated at Bellevue Hospital, New York, the adult death rate was 1.5 per cent. and the child death rate, 12.9 per cent. The conclusion was that sulfanilamide is considerably more effective than treatment with erysipelas antitoxin or with serum, ultraviolet rays, x-rays or local treatment with dressings.

COOPERATIVE AGRICULTURAL RESEARCH BETWEEN BRAZIL AND THE UNITED STATES

THE arrangement for cooperative agricultural research included within the new Brazil-U. S. trade agreement is part of a greater plan which is intended to extend American research facilities to all tropical American countries, with a view to mutual interchange of products that will not interfere with existing agricultural systems. Possible developments under the new arrangement include: reestablishment of the Para rubber industry, now largely in the hands of the British and Dutch in the East Indies; stimulation of existing trade in cacao, cubé (for insecticides), palm oils and waxes, manioc, etc.; development of traffic in tropical fruits through better refrigeration facilities; experimentation in new crops like tea, spices, hemp and jute.

Bills now before Congress call for appropriations to finance three specific projects: The establishment of a new agricultural attaché in Rio de Janeiro; a survey of the tropical resources of Brazil by scientists of the U. S. Department of Agriculture; and the loan of Department of Agriculture research workers to investigate problems of Brazilian farms and forests.

Similar set-ups for other Latin-American countries are contemplated. Additional agricultural attachés are planned for Mexico City, Havana and Panama. There is already one in Buenos Aires.

Other parts of the general plan call for the training of South American meteorologists by scientists of the U. S. Weather Bureau, the establishment of a tropical forest experiment station in Puerto Rico, cooperation with radio companies for the transmission and dissemination of information, and the publication of scientific results after translation into Portuguese, Spanish and French.

ITEMS

BY March influenza should be on the wane. Instead the number of cases reported each week to the U. S. Public Health Service continues to increase. The number for the week ending March 11 was over 18,000. The total number for the previous week was 14,228. Virginia has been hardest hit of all the states and again reported the largest number of cases, 1,991 for the week. The epidemic seems headed westward. Cases in New Mexico jumped from 57 to 677, in Arizona from 144 to 191, in Oregon from 97 to 261, in sparsely populated North Dakota from 364 to 741, and in Wisconsin from 584 to 1,516. The brunt of the epidemic, nearly three fourths of the cases, was borne by the following six states: Wisconsin, Virginia, South Carolina, Kentucky, Alabama and Arkansas. New England and the Middle Atlantic states have had practically no influenza this year.

A SINGLE cosmic ray of high energy can create 50,000 other particles in a tremendous "burst" of atomic energy, Professor Enrico Fermi, Nobel laureate in physics for 1938, told the joint meeting of the Washington Academy of Sciences and the Philosophical Society of Washington. Professor Fermi, formerly of the University of Rome and now at Columbia University, said that a cosmic ray with a thousand million million (1,000,000,000,000) electron volts of energy could produce such bursts over an area of about three hundred square yards. Discussing the "mesotron" particle—the new atomic particle which is about one hundred times as heavy as an electron—Professor Fermi credited the young Japanese physicist Yukawa with predicting the existence of such particles several years before their discovery in cosmic radiation. Yukawa, however, suggested the particles to interpret the inner binding energies with the hearts of atoms. It is the mesotron particle that now appears to account for the enormous piercing power of many cosmic rays which can pass through a whole yard of dense lead or into the earth, where they have been detected in deep mines.

THE lag in aeronautical research behind Europe is the chief cause for alarm in the American aviation picture, G. Grant Mason, Jr., member of the Civil Aeronautics Authority, told the Society of Automotive Engineers at its national aeronautic meeting in Washington. Expanded European research facilities, combined with quantity production facilities, may produce a surplus of high performance commercial airplanes which will cut seriously the American export market. "With that situation confronting us, the President has transmitted to Congress a request for an additional $12,140,000 for the construction of new research facilities at Langley Field and for a new laboratory at Sunnyvale, California, for the National Advisory Committee for Aeronautics. Congress is considering additional legislation designed to stimulate greatly increased experimentation and development by the industry."

A PRACTICAL radio tube generating an ultra short-wave but five and a half inches long—short enough for the radio echo altimeter now under development to show pilots how high they are above the ground and to warn them of other planes near-by—is announced by two engineers of the General Electric Company, W. C. Hahn and G. F. Metcalf. Its waves, a fourth as long as the waves now used in experimental echo altimeters, can be directed like the beam of a searchlight. Waves as short as a single centimeter—about two fifths of an inch—can be generated by a tube working on the same principle. The shortest wave received on a home radio set is about five meters, or more than 15 feet. The tubes can also be used for guiding ships through dense fogs by enabling them to measure the distance to land or other vessels.

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SCIENCE NEWS

Science Service, Washington, D. C.

HIGH PRESSURES

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THE highest useful pressures ever created in the laboratory by man, one and a half million pounds per square inch, have been achieved through experiments by Dr. Thomas C. Poulter, formerly second in command and senior scientist of the Byrd Antarctic Expedition and now director of the research foundation of the Armour Institute of Technology in Chicago.

To the University of Pittsburgh's industrial physics conference at Mellon Institute, Dr. Poulter told how he is now exploring the realms of high pressure instead of braving and studying the low temperatures of Antarctica.

Safer serums for the prevention and treatment of disease are expected through use of high pressures. Pressures of about 180,000 pounds per square inch kill certain bacteria, and it is hoped that they can be used in manufacture of serums instead of heat.

At 400,000 pounds per square inch pressure, ordinary automobile lubricating oil becomes as hard as metallic lead and copper at ordinary pressures. This is important industrially because these pressures are actually reached in some ball-bearing machinery.

High pressures can also precipitate colloids and particles out of solutions and this may find industrial applications.

High pressure applied to milk for a short time will keep it sweet for a month, other experimenters have found, but commercial application will be slow because of the difficulties of applying the pressure. Meat can be preserved in a like manner.

Dr. Poulter's research also shows that the atoms themselves are actually compressed by high pressure, not just moved closer together, causing lower energy levels within the atoms.

At the extreme pressure of 1,500,000 pounds per square inch lubricating oil was compressed to half its original volume.

WATSON DAVIS

THE VÄISÄLÄ COMET AND THE PONS-WINNECKE COMET

WHEN Professor Y. Väisälä, of the University of Turku, Finland, recently reported the discovery of a new tiny asteroid, astronomers throughout the world were interested but not surprised, for the Finnish astronomer is a specialist in finding such stellar wanderers.

They were surprised, however, when they learned that the asteroid, provisionally called object 1939 CB, had been found to be a comet with a ten-year period as a result of new observations by Professor Väisälä. The new discovery has been reported by radio to the American collecting center for American astronomical information, Harvard College Observatory.

The new Väisälä comet is very faint, of the fifteenth magnitude, and can be seen only with powerful telescopes. It is located in the "sickle" of the constellation Leo just north of the bright star Regulus. It passes the north-south meridian line about 9:30 o'clock in the evening. On March 15, its position was right ascension 9 hours, 37 minutes and six seconds and its declination plus 23 degrees seven minutes.

The comet has been found to possess a short tail, about one degree in length, by Professor G. Van Biesbroeck, of the Yerkes Observatory. It is unusual for a comet so small (fifteenth magnitude) to have a tail.

Observed by Dr. H. M. Jeffers, of the Lick Observatory, University of California, is the Pons-Winnecke comet, now back in the region of the sun and visible to powerful telescopes on earth. This comet is near the constellation of Bootes, which contains the bright star Arcturus. The comet passes the meridian line about three o'clock in the morning. Position of the Pons-Winnecke comet on March 17 was right ascension 14 hours, 36 minutes and 11.7 seconds and declination plus 31 degrees, 20 minutes and four seconds. At that time it was very faint, about the seventeenth magnitude.

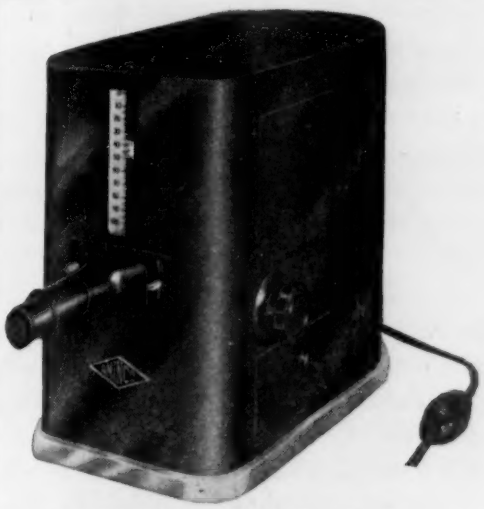
VACCINE FOR PROTECTION AGAINST INFLUENZA

A VACCINE for protection against influenza and solution of the problems of virus-caused diseases such as infantile paralysis may be achieved by a new scientific approach described by Professor Ernest W. Goodpasture, of Vanderbilt University School of Medicine, at the meeting in New Orleans of the American College of Physicians.

This approach or technic, using chick membranes to grow viruses, may prove as valuable for the conquest of virus-caused diseases, though in a different way, as the new chemical, sulfanilamide, has proved for conquest of bacteria-caused diseases like streptococcus infections.

The anti-influenza vaccine particularly seems very close at hand. The virus of epidemic influenza, when cultivated on successive chick membranes, lost its disease-producing power to such an extent that it did not cause sickness when dropped into the nose. At the same time, it increased the level of the body's own flu-fighting forces in about one half of those tested. Development of this weakened virus with good immunizing ability, which Professor Goodpasture called "very promising for an eventful successful vaccine for human epidemic influenza," was achieved by Dr. F. M. Burnet and collaborators, at the Hall Institute, Melbourne, Australia.

This and the possible solution of other virus disease problems all hinge on the original discovery by Professor Goodpasture and his associate, Dr. A. M. Woodruff, that the chorio-allantois of developing chicken eggs is an ideal substance on which to grow the virus that causes fowl-pox. It has since been found that this same membrane of the developing chicken egg can be used for cultivating viruses of other diseases, including yellow fever and influenza, and for studying these viruses. Bits of human skin can also be successfully grafted on to the egg membrane and the grafts can be used to study virus infections.



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Yellow fever vaccine, which has been used on over a million persons in South America, is now being produced from chick embryos. Vaccine used to protect animals against the so-called horse sleeping sickness, which has spread to humans and killed several children last fall, is also being produced from virus grown on chick embryo membranes. If a vaccine is needed to protect human beings from this animal plague, it may be produced in the same way.

Viruses such as cause these ailments and the more familiar infantile paralysis, unlike other disease germs, can not be grown on chemicals outside the body. For this reason progress in the control of such diseases has lagged behind that in other diseases whose germs can be more easily cultivated and studied. Heretofore laboratory animals and expensive monkeys have been used in attempts to conquer the virus diseases. The chick membrane technic is far superior, Professor Goodpasture believes, and should be more extensively used.

BARRIER AGAINST PNEUMONIA GERMS

THE body's Maginot Line against invading pneumonia germs, which bars their passage from lungs to blood, may have been located as a result of research reported by Dr. O. H. Robertson, of the University of Chicago, at the meeting of the American College of Physicians.

In the depression of the lung known as the hilum are lymph nodes which Dr. Robertson believes "may constitute the principal barrier to the passage of pneumococci from the infected lung into the blood."

The blood has certain natural pneumonia-germ-killing powers. Studying this during the course of pneumonia in dogs, Dr. Robertson found that usually so long as the blood could kill the germs, none could be found in the blood and the animal recovered. In numerous cases, however, the germs were found in the blood even when the blood had marked germ-killing ability. Given sufficient time, however, such blood, in test-tube experiments, was capable of destroying large numbers of pneumonia germs. Apparently the blood's ability to destroy the germs is not the only factor in keeping them out of the blood during the disease. Searching further, Dr. Robertson found that in dogs with pneumonia, but with no pneumonia germs in their blood, large numbers of these germs were often found in the lymph nodes. This and other findings suggested that the lymph nodes in the hilum of the lung act as chief barrier between lungs and blood.

THE DIAGNOSIS OF INFLUENZA

THAT specific diagnosis of epidemic influenza is now possible, was reported by Dr. Thomas Francis, Jr., of New York University College of Medicine.

Lack of such a specific diagnostic test for this ailment has been one of the stumbling blocks in the way of getting an accurate report of cases during an epidemic. The specific diagnosis is possible when it was discovered that a filterable virus, believed the cause of the disease, can be obtained from throats of patients suffering from epidemic influenza, and because methods have been developed for using mice in studying this virus. Not all the cases that occur in the course of an influenza epidemic are the same disease, Dr. Francis reported. In fact, the various epidemics of supposed influenza are not the same disease.

A person who has had influenza acquires immunity or resistance to the disease, though Dr. Francis did not say how long this immunity lasts. Healthy carriers of influenza—persons infected without showing any signs of it—probably play an important part in keeping the infection going and spreading the disease.

SOYBEANS

SOYBEANS, the crop without a surplus, received high praise from agricultural and chemical leaders, at the fifth annual meeting, at Jackson, Mich., of the National Farm Chemurgic Conference.

G. G. McIlroy, of Irwin, Ohio, president of the American Soybean Association, described the spread of soybean cultivation in the United States. In 1930, he said, the American soybean crop was only nine million bushels. In 1938 the production reached fifty-eight million bushels.

Illinois is the leader in soybean culture. This one state produced more than half of last year's crop, thirty-one million bushels. With four other neighboring states, from Iowa across to Ohio, a new "Soybean Belt" is growing up, that at present accounts for more than nine-tenths of the national production.

Although soybean culture began in the South, it has not increased rapidly in that part of the country. Southern farmers are now putting in a larger share of the national soybean acreage.

Soybeans are capable of use on the farm, as hay or ensilage, and the press cake left after oil extraction is also good for either feed or fertilizer. But large and ever-increasing uses are found in industry. Henry Ford attracted a lot of attention to soybeans a few years ago, when he undertook the use of soybean meal as a material for steering-wheels, panels, knobs and other plastic parts. But the real follow-through has been given by scores of less prominent figures in many industries.

H. W. Galley, of the National Soybean Processors Association, Decatur, Ill., told of some of the manifold uses of soybean oil. Refined, it has proved to be a very good food oil. Last year forty million pounds were used in the margarine industry, a jump from 1,750,000 pounds three years ago. Heavy use of the natural oil is made in paint, varnish, linoleum and other manufactured products requiring drying oils.

Along with soybean oil naturally goes the oil meal left after extraction. The meal or its proteins have been used in plastics, as sizing and glue, and in the preparation of numerous foods for human consumption. However, said Dr. J. W. Hayward, chairman of the Soybean Nutritional Research Council, Minneapolis, 95 per cent. of soybean oil meal is still used for feeding livestock. This is and should remain its major use, in his opinion.

THE TUNG OIL INDUSTRY

C. C. CONCANNON, chief of the chemical division in the Bureau of Foreign and Domestic Commerce, told the meeting of the American Tung Oil Association meeting at Gulfport, Miss., that the United States needs to grow

and process more of its own tung oil, to render American manufacturers of paint, varnish, linoleum and other commodities independent of the Chinese supply.

Tung oil is produced from the nuts of two species of trees that grow in the hill country of China. Its quick-drying properties make it indispensable in many industrial processes. Substitutes have been sought at times of high prices, but nothing satisfactory has been found.

First serious experiments in the development of an American tung-oil industry began something over thirty years ago, and some of the trees planted then are still bearing well. They require light, well-drained, acid soil and a frost-free climate, so that they can be grown in this country only in a zone along the Gulf Coast and across the northern part of Florida. At present there are about 175,000 acres in tung trees, but most of them are young and not yet bearing.

The principal supply of the oil therefore continues to come from China. This country takes almost all the oil exported by the Chinese. In 1937 our imports amounted to 175,000,000 pounds of tung oil, valued at $20,000,000. Last year there was a drop to 108,000,000 pounds, worth $12,000,000. There is a considerable hold-over stock now on hand—61,500,000 pounds as of December thirty-first, 1938.

COTTONSEED OIL

SPEAKING at the National Farm Chemurgic Conference, Dr. H. P. Stuckey, director of the Georgia Experiment Station, pointed out that cottonseed oil was once a mere by-product of the cotton industry. Now, cotton bales pile into mountains that are a national economic headache, while the market is still thirsty for the oil.

National production of cottonseed oil in 1938 was 1,683,000,000 pounds. The food industries absorbed nearly all of it, taking 1,529,000,000 pounds. About two thirds of this quantity—1,040,000,000 pounds—went through the hydrogenation process, to become shortening. Oleomargarin accounted for 143,000,000 pounds, and an additional 198,000,000 pounds went into other food uses. The relatively small residue was absorbed into industry, principally soap making.

How to get more oil without further increasing the surplus of cotton is the problem. Breeders may have to reverse their efforts of recent years, which have constantly been aimed at raising the ratio of lint to seed. "Seedier" cotton varieties may actually be demanded.

It has even been proposed that cotton-for-lint be given up in part, and a lintless cotton, developed from the "bald-headed" stalks that frequently crop up as mutations, be raised as a straight oil-seed crop, harvested by machinery. This is not an impossible suggestion, for cotton is evolutionally derived from plants with lintless seeds, being a member of the mallow family.

New outlets for cotton fibers were also up for discussion at the conference. A possible major use is in the building of the so-called cotton roads. In these roads, wide strips of cotton are laid down on the prepared ground as foundations for tar, asphalt, crushed rock and other surfacings. Clinton T. Revere, of New York City, stated that large-scale experiments in the South have already conclusively demonstrated the practicability of such roads.

ITEMS

PROVISION of improved weather forecasting service along the Atlantic and Pacific coasts, asked by the Air Safety Board of the Civil Aeronautics Authority in a series of recommendations designed to prevent repetition of an accident three months ago which cost five lives, has been laid squarely in the lap of Congress. Improvements in Weather Bureau operations are limited by the funds provided by Congress, Commander Francis W. Reichelderfer, chief of the Bureau, declared. Funds earmarked in the 1939–40 budget for the Bureau will permit extension of services, but not to the extent urged by non-governmental air and weather experts, or by the Air Safety Board. The aviation body wants more reports from ships as well as more radio-meteorograph observations from land stations. It also asks more predictions of winds pilots will encounter, and a new type of airway weather map showing conditions at different altitudes.

PAA–17, the first of four Boeing clippers which will go into service on a transatlantic airline this spring, has arrived at the Baltimore terminus of the line. The ship, capable of carrying between 40 and 50 passengers across the Atlantic at a time, was flown from San Francisco, where it had been undergoing operation tests. Three more planes, of which one has already been delivered and another is due in a matter of days, will follow at a later date. The first clipper's eastward journey was *via* the Pacific coast, across a narrow part of Mexico, and then across the Caribbean and up the Atlantic coast.

RADIO echoes promise to help make aerial maps. Hailed as 1938's outstanding contribution to air safety, the echo altimeter tells a pilot just how high he is above the ground. It not only can prevent mountainside crashes but it traces the contour of the ground below. To the American Society of Photogrammetry meeting in Washington on January 16 two Bell Telephone Laboratories engineers, Russell C. Newhouse and Lloyd Espenscheid, responsible with Peter C. Sandretto, of United Air Lines, for the echo altimeter's development, explained that theoretically it can show changes in ground height as small as 10 feet. The echo altimeter sends a radio beam earthward whose frequency is being continuously changed up to 500 megacycles. A frequency measuring device compares the reflected beam, which has taken time for its journey proportional to the transmitter's distance from the earth, and the beam just being sent out, to tell the elapsed period of time between sending and return of the beam. This is an exact measure of the distance of the transmitter or the plane above the earth.

GLASS stronger than steel is now being produced by investigators engaged in developing glass fibers for weaving into "fabrics of tomorrow." By careful melting to remove as much as possible dissolved gases and bubbles so as to reduce strength-killing "discontinuities" in the fiber, fiber glass with a tensile strength of 400,000 pounds to the square inch can be made according to the report of F. O. Anderegg, of the Owens-Corning Fiberglass Corporation. Glass and other materials, Dr. Anderegg states, can potentially be made to be far stronger than they are, but impurities giving rise to discontinuities must first be reduced or eliminated.

NEW BOOK AND INSTRUMENT CATALOGUES

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CHEMICAL PUBLISHING COMPANY, INCORPORATED, New York. *Important Books.* Pp. 36.

CHRONICA BOTANICA COMPANY, Leiden, Holland. *Bulletin for 1939; Agronomy, Botany, Forestry, Horticulture.* Pp. 16.

DU PONT DE NEMOURS AND COMPANY, INCORPORATED, Wilmington. *The Neoprene Notebook, 13.* Pp. 4. Illustrated.

FISHER SCIENTIFIC COMPANY, Pittsburgh. *The Laboratory; Vol. 10, No. 4.* Pp. 62–80. Illustrated.

LEITZ, E., INCORPORATED, New York. *Leica Photography, March, 1939; Vol. VIII, No. III.* Pp. 28. Illustrated. Price, 10 cents.

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OXFORD UNIVERSITY PRESS, New York. *New and Forthcoming Books, Spring, 1939.* Pp. 70.

RANSDELL, INCORPORATED, Washington. *Books, 1939, from the Nation's Capital, of Timely Interest on World Problems.* Pp. 32.

SCOTT FORESMAN AND COMPANY, Chicago. *Sample Pages from "Science Problems," Books 1 and 2 for the Junior High School.* Illustrated.

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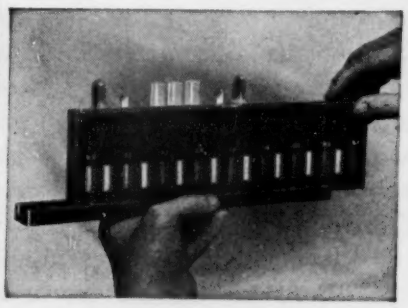

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RADIO-ACTIVE SODIUM PHOSPHATE AND LEUKEMIA

PROFESSOR ERNEST O. LAWRENCE, of the University of California, speaking before the New Orleans meeting of the American College of Physicians, reported that radio-active sodium phosphate may be the life-saving weapon of the future against leukemia. Eight patients suffering from this always fatal cancer-like disease of the white cells of the blood are being given this treatment now at the School of Medicine of the University of California.

It is much too soon, Professor Lawrence emphasized, to be sure whether the results of this new treatment will be lasting and the patients permanently cured. So far, however, they are doing well. They may have to take their daily drinks of radio-active sodium phosphate in water for the rest of their lives, as diabetics take insulin. At present the new treatment keeps them well, as x-ray treatments do. Leukemic patients become immune to x-ray treatments after a time, however, and are no longer helped by them. Professor Lawrence and his brother, Dr. John Lawrence, who is in charge of the medical work, hope that the radio-active material will continue to prove effective. The sodium phosphate is made radio-active in the giant atom-smashing cyclotron which has been developed by Professor Lawrence as a tool for physical studies of atoms.

The cyclotron is also being tried as a weapon against cancer. Patients with advanced cancers have been getting weekly treatments since September with powerful neutron rays from the cyclotron. These rays are more powerful than x-rays and have a different effect on tissues. The tumors have regressed, but, as with the leukemia patients, it is much too soon to know how lasting the results of the treatments will be.

White mice that had been given radio-active sodium phosphate showed their radio-active personalities to the physicians here by making a Geiger counter click when Professor Lawrence brought this instrument near their bodies. The Geiger counter is used to detect radio-activity of either natural radium or artificial radio-active substances. Cut flowers in a vase containing radio-active sodium phosphate in the water produced the same clicking on the Geiger counter.

This instrument, Professor Lawrence predicted, will be installed in every medical laboratory in the future. Physicians will use it to detect tagged atoms of phosphorus, common salt, iron and iodine in patients' bodies. The tagged atoms of radio-active materials will have previously been injected or given in a glass of water. The Geiger counter will show whether the substance spread through the body normally or not and thus will aid in diagnosis of diseases due to faulty assimilation or utilization of necessary chemicals such as iron, iodine, salt and the like.

A drink of radio-active salt water shows in the finger tips in about twenty minutes. This is the time it takes the radio-active salt to reach the finger tips via the blood. The method is already being used to test the rate of blood circulation in patients with heart ailments.—JANE STAFFORD.

SULFAPYRIDINE AND PNEUMONIA

ALMOST all deaths from pneumonia could now be prevented if pneumonia patients were given proper treatment on the first day they got sick, according to a report made by Dr. Perrin H. Long, of the Johns Hopkins School of Medicine, to members of the American College of Physicians meeting in New Orleans. The millennium of no more pneumonia deaths, which probably could be achieved by the new chemical remedy, sulfapyridine, will probably never be reached, Dr. Long said, because pneumonia patients do not see a doctor on the first day they are sick—in fact, usually not until they are desperately sick.

Sulfapyridine, however, has cut the pneumonia death rate at the Johns Hopkins Hospital by two thirds, Dr. Long reported. Only eight patients have died of pneumonia there since last July 1, when sulfapyridine treatment was started. Of these, four had pneumonia serum treatment alone, one had serum plus sulfapyridine, and three had sulfapyridine alone. The total number of pneumonia patients was 107.

Serum would not be necessary in the treatment of pneumonia, Dr. Long said, if sulfapyridine could be given the patient the first day of his illness. From the standpoint of cost alone this would be a tremendous advantage. It costs about twelve dollars to treat a case of pneumonia by sulfapyridine but the cost of serum treatment is at least seventy-five dollars. Serum is not always available, whereas sulfapyridine is both available and effective in all types of pneumonia.

Dr. Long and Professor E. K. Marshall, Jr., of the Johns Hopkins School of Medicine, have increased the efficiency of sulfapyridine by combining it with sodium. This makes it possible to inject the drug into the patient's vein, an advantage because in the first place many pneumonia patients are too sick to swallow medicines and in the second place it makes the drug act faster since it is now possible to get the most effective concentration of the drug in the blood within five minutes.

Sulfapyridine saves pneumonia-threatened lives apparently by slowing down the growth of the pneumonia germs. This gives the patient a chance to build up his own immunity or resistance to them and so to recover. After the drug has been given the temperature goes down but the patient still has pneumonia until his immunity reaches the point of overcoming the invading germs.

Sulfapyridine is also useful in treating infections with staphylococci, the germs which cause boils, among other things. It is too expensive to be used for boils but is being used in more serious staphylococcus infections. It is not, however, the final answer in these conditions. Something better must be found, Dr. Long said.

For streptococcus infections, the chemically related and

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This entirely new treatise, 15 years in preparation, is both a readable and an extremely painstaking account of the science of electrochemistry as it is to-day. Careful arrangement of the subject matter and logical development of the concepts involved make it particularly desirable for use as a textbook. The basic principles of electrochemistry are discussed and critically evaluated: and the foundation thus laid is used as a basis for the introduction of more recent ideas, such as the extension of the Debye-Hückel theory, the application of the interionic attraction theory to electrolytic conductance, the use of the glass electrode and the Tiselius electrophoresis technique for the study of proteins. Every effort has been made to achieve the highest possible level of accuracy throughout the book.

It contains an excellent introduction to the thermodynamics of electrochemistry and it is particularly comprehensive in its treatment of electrode potentials. It gives the modern theoretical status of the basic principles of electrochemistry, with emphasis on the interionic attraction theory. The latter is a field to which the author has contributed invaluable experimental verification.

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Dr. MacInnes, a member of the National Academy of Science, now in charge of electrochemical research at the Rockefeller Institute for Medical Research, was formerly a professor at Massachusetts Institute of Technology, is also a past president of The Electrochemical Society. This book will be indispensable to chemists, physicists, engineers, and biologists—in short to everyone who wishes to maintain close contact with one of the most important and fruitful developments of modern science.

An idea of the scope of the book is given by the table of contents as follows:

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The Effects of Gravity and Centrifugal Force on the Electromotive Force of Galvanic Cells
Standard Electrode Potentials from Galvanic Cells without Liquid Junctions
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Thermodynamic Studies of Non-Aqueous Solutions
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The Determination and Meaning of pH Valves
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older sulfanilamide is more reliable than sulfapyridine because it is more readily absorbed. At least five million persons in the United States have been treated with sulfanilamide, Dr. Long estimates, since he first introduced it from abroad in the fall of 1936.—JANE STAFFORD.

NICOTINE ACID AND PELLAGRA

A FURTHER step toward eradication of pellagra, Dixie's hard-times disease, appears possible in the light of a report made by Dr. Tom Douglas Spies, of the University of Cincinnati and the Hillman Hospital, Birmingham, to the American College of Physicians.

New knowledge of how nicotinic acid cures pellagra by its effect on the body's chemistry was also reported by Dr. Spies. The chemical achieves its curative effect, at least in part, through its effect on one of the body's enzymes or ferments, codehydrogenase.

As an advance toward conquest of pellagra, it is now possible to detect the disease long before the rash and sore tongue appear, and to prevent these and other more serious symptoms of the ailment, such as the mental delusions. Physicians should suspect pellagra, Dr. Spies advises, in patients who for a long time have had "vague, grumbling complaints" without apparent cause, loss of weight, strength and appetite, and indigestion. Cross, fretful children who for years have been below normal in weight and height and whose school progress has been slow should also be suspected of being in the early stages of pellagra. Investigation of the patient's diet and certain chemical tests of blood and other fluids will clinch the diagnosis. Treatment with nicotinic acid in this early stage of the disease will quickly bring such patients back to good health.

Studying the diets of fifty pellagra patients, it was found that in almost every case the patient had not been getting enough calories, proteins, lime salts, iron and vitamins. In other words, they had not been getting enough meat, milk, eggs and fresh fruits and vegetables.

People living on such diets get not only pellagra but other ailments, such as the nerve disorder, beriberi. Nicotinic acid will cure the pellagra, but to cure the other conditions certain other chemicals, the new synthetic vitamin B and flavin, are needed. Since both these and nicotinic acid can be obtained from food, the importance is urged of a good diet for pellagra prevention. While the ailment is most common in poverty-stricken people, it also occurs in persons who follow an inadequate diet because of illness, chronic alcoholism or addiction to diet fads.—JANE STAFFORD.

THE ROLE OF VITAMIN A IN THE BODY

MAN'S nearest approach to a perfect vacuum is aiding science to learn more about vitamin A, the dietary element which helps human vision and aids in preventing body infections. This new feat was reported to the American Chemical Society meeting in Baltimore by Dr. Edward LeB. Gray, of the research laboratories of Distillation Products, Rochester, N. Y.

With the aid of special pumps in which molecules of oil "sweep out" air from the vacuum chamber, it has at last been possible to distill vitamin A_2, a rare form of the vitamin which has recently been found. Vitamin A_2 has been isolated from the livers and eye retinas of fresh-water fish where it appears to have the same rôle as ordinary vitamin A.

Vitamin A combines with protein in the retina of the human eye to form visual purple, an essential element in vision. Absence of vitamin A leads to so-called night blindness in which vision is impaired temporarily by the glare of bright lights.

A significant point in the new work is that vitamin A and vitamin A_2 distill at the same temperature, indicating that the two compounds must be very close to one another if not identical in size.

"When the complete structure of vitamin A_2 has been worked out," Dr. Gray indicated, "the biochemist will have two compounds of known structure playing the rôle of vitamin A in the body instead of one, and thus give a clue to the functional group responsible for its vitamin activity. This, in turn, will aid in shedding light upon the rôle of the vitamin in the living organism." As the picture now stands it appears that perhaps only a significant part of the large vitamin A molecule is needed to give its physiological effects.

Distillation at the extremely low pressure of one thousandth of a millimeter of mercury is necessary in the new research so that the vitamin A_2, which is extremely sensitive to heat, will not be decomposed by the heat before it is distilled.—ROBERT D. POTTER.

MILK AS A RAW MATERIAL FOR INDUSTRY

THE days when the farmer's milch cow could be considered solely as a food "factory" are no more. Through modern chemistry the modern cow has taken on added stature as a source of raw materials for industry. Milk, butter and cheese are still the main output but more and more hitherto waste, or low-valued, products of the dairy industry are finding wider uses.

The dairy industry is just beginning to find out how to dispose of the whey—at a profit. Specialists from the Department of Agriculture's Bureau of Dairy Industry told their colleagues at the meeting in Baltimore of the American Chemical Society how to do it.

Skim the cream off whole milk and you can use the fat to make butter. Coagulate the skimmed milk with acids and you can get the curds out of which casein is obtained. What you have left is the straw-colored liquid known as whey. Little used, before now, this whey contains nearly fifty per cent. of the solids of the milk. In terms of the national picture 420,000,000 pounds of milk solids are available annually. Of these solids, according to the report of the government chemist, A. Leviton, about seventy per cent. consists of valuable milk sugar. Another eight per cent. are proteins that coagulate on heating, and the balance consists of salts of milk. Present, too, are significant water-soluble vitamins, particularly vitamin G, known as riboflavin. With new methods of extraction employing alcohol, the yields of milk sugar have been markedly improved. Proteins are obtained in soluble form that differ from the ordinary insoluble proteins in the same sense that the albumin of fresh un-

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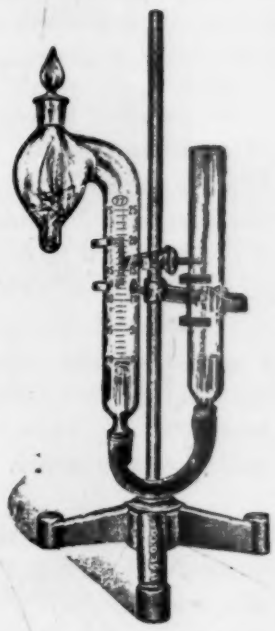

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cooked eggs differs from the coagulated albumin of boiled eggs.

Not only is the "mining" of whey for its chemical products being done more efficiently, but the whey itself is used in a variety of ways. Dr. Lee T. Smith and H. V. Claborn reported methods of treating the whey to produce a rubber-like substance known as polymethylacrylate. This material, looking quite like a kind of clear art-gum eraser product, is highly elastic, very tough and is not discolored by sunlight. Applied to fabrics, it renders them impervious to the passage of gases. One of its potential uses is for sealing clothing against war gases.

From the casein of milk chemists produce plastic materials which have been used for buttons, telephone handsets and steering wheels on automobiles. But the casein can be used, too, to produce fibers for weaving into beautiful fabrics closely simulating wool. Drs. Earle O. Whittier and Stephen Gould described their methods of making this synthetic wool from cow's milk. These scientists have obtained the first American "public service" patents for the development.

Synthetic wool was first developed in Italy where commercial production is now under way. Italy's motive has been the finding of a wool-substitute and thus avoiding the need for importing large amounts of natural wool. This war-scare motive has been an important factor in many chemical developments abroad.

The exhibit, "Fabrics of the Future," which Science Service is now sending on tour throughout the United States contains a woman's dress woven from a combination of this synthetic wool and natural wool. The casein in the dress cost only 50 cents. Drs. Whittier and Gould cited this exhibit in their report.

The free government patents on making synthetic wool improve on the Italian work in that they can be applied to casein obtained from other than cow's milk. In fact, the use of casein is only for its protein content and so synthetic "wool" has been made, experimentally, out of many other proteins. In the United States soybean protein has been used. In Germany and in Japan, the protein from fish has been turned into a synthetic wool-like fiber.—ROBERT D. POTTER.

NATURAL GAS AND HIGH EXPLOSIVES

AMERICA'S potential wartime needs of high explosives can now be made from natural gas, air and steam, it is announced by Professor Henry B. Hass, head of the department of chemistry at Purdue University, who presented the technical details of his discovery at the ninety-seventh American Chemical Society meeting at Baltimore.

The way to make two new explosives, nibglycerol trinitrate and nibglycol dinitrate, from these abundant and cheap raw materials is significant, for the new chemicals possess properties comparable with nitroglycerol, used for dynamite and military explosives. This research will give the nation potential freedom from dependence on glycerol, common basic material of many explosives used to-day. Glycerol is a comparatively minor product of the soap industry.

Development of explosives from natural gases is helpful to America, for ninety-eight per cent. of the world supply of such gas is concentrated within the continental United States. An insignificant fraction of this gas would furnish all the high explosives which could ever be used. The new explosives are as powerful as nitroglycerol and yet are only half as sensitive and can therefore be handled with greater safety.

Working with Professor Hass in the original experiments on nitration were H. J. Hibshman and E. H. Pierson, Purdue Research Foundation fellows.—ROBERT D. POTTER.

ITEMS

THE best gasoline mileage for motor cars is in the range of moderate speeds, around twenty-five miles an hour. This fact was reported at the southeastern meeting of the American Physical Society by Professor J. R. Derieux, of the North Carolina State College at Raleigh. In a speed range from five to 60 miles an hour, it was found, the maximum mileage was achieved at 25 miles an hour and an average of about 20 miles to the gallon was obtained. At five miles an hour, the mileage per gallon was about 14, while at 60 miles an hour, 12 miles to the gallon was recorded.

COPPER, passed through the skin by electric current, is being successfully used in treating fungous infections of the hands and feet by physicians at Yale University Medical School. Of 37 patients treated at Yale by means of electric current, 26 have been discharged as cured. Some of them had severe infections of long duration, one for as long as 25 years. The average number of treatments given was six. The patient sits with his feet immersed in enamel pans and with the hands in other basins. When the infection is on the feet, the hands are immersed in salt solution and the feet in 0.5 per cent. copper sulfate solution. For infections of the hands the relations are reversed. Dr. Howard W. Haggard, Dr. Maurice J. Strauss and Leon A. Greenberg describe the new treatment in a preliminary report in the *Journal* of the American Medical Association for April 1.

THE construction of new hospitals is proceeding at an unusually swift pace. At the same time existing hospitals have more idle beds than they had a year ago, the *Journal* of the American Medical Association states in its annual hospital number. For the first time since 1930 the number of registered hospitals has increased over the previous year, the journal survey shows. A year ago there were 6,128 registered hospitals. To-day there are 6,166. The growth of hospital facilities has outstripped the advance in population. Such increases in proportion to population can not be maintained indefinitely. During 1938 the net gain in registered hospital facilities was equal to a 101-bed hospital for each day of the year. In 1938, there were 9,421,075 patients admitted to registered hospitals. That means that one person in every 14 spent some time in the hospital. The average stay per patient in general hospitals was 12.5 days. More than a million babies, 1,026,771 to be exact, were born in hospitals during 1938.

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SCIENCE NEWS

Science Service, Washington, D. C.

TRACING CHEMICAL ELEMENTS IN THE BODY

PROFESSOR VINCENT DU VIGNEAUD, head of the department of biochemistry at Cornell University Medical College, New York City, in an invited address before the meeting of the American Chemical Society in Baltimore, stated that atom-smashing experiments of pure research physics have given an unforeseen and inestimably valuable tool for studying the use of chemical elements in the body.

Out of atom smashing, which at first seemed important only in the realm of nuclear physics, has come the ability to make almost any chemical element radio-active so that it gives off detectable radiations. It is thus possible to feed these chemical elements to man and animals and study, step by step, their pathways through the human body. Out of this knowledge has come new facts never before known about the behavior of the body.

Studies of phosphorus in the body, most important for creating bony structure, have shown that 62 per cent. of the phosphorus absorbed goes into the bony structure within five days, said Professor du Vigneaud. These tests are so sensitive that scientists can detect .000,000,000,005 milligram (5×10^{-12}) of the material present.

Another experiment performed with radio-active sulfur, Professor du Vigneaud said, shows that the phosphate compounds of the brain were constantly being regenerated.

Not only are radio-active elements useful in tracing how the body uses its food but also the stable isotopes of chemical elements can be used as labels for body reactions. Thus the heavy kind of hydrogen of mass two, instead of mass one, has been employed to study the mystery of fat, cholesterol and protein metabolism. It was found that the fatty acids in the body were replaced about every three days in rats; a completely unsuspected finding. This same type of research, carried on at Columbia University, showed that fatty acids were converted, one into another, in the body. Thus stearic acid was found to turn into palmitic acid.

The use of the heavy-weight kind of nitrogen also has yielded knowledge that the breakdown of protein material in the body occurs much faster than previously supposed. Using heavy nitrogen of mass 15, it has recently been possible to follow through the transitions of the complicated amino acids in the body. These acids are the structural building blocks out of which body proteins are built up, Amino acids are also known to help to create the still-mysterious enzymes which serve as catalysts in the body to turn food products into actual body tissues.—ROBERT D. POTTER.

SEPARATING ISOTOPES TO TRACE CHEMICAL ELEMENTS IN HUMAN BODY

THAT swirling whirlwinds of heat waves constitute the newest method of separating isotopes of the chemical elements was announced at the meeting of the American Chemical Society by Drs. Arthur Bramley and A. Keith Brewer, of the U. S. Bureau of Chemistry and Soils, Washington.

Separating the chemically-indistinguishable forms of elements known as isotopes is a major goal of science, for by isotopes it is possible to trace the paths of atoms from one compound to another through the intricate chemistry of the body. By such "tracer" atoms a whole new frontier of physiology can be opened whose importance may be as great as the discovery of the microscope. The microscope enabled scientists to see individual cells of an organism; the use of isotopes enables them to study the individual atoms in those body cells.

Up to a year ago only pure isotopes of hydrogen and nitrogen were available in sufficient quantities to make possible important chemical and biological researches. The new method of thermal "whirlwinds," however, permits the concentrations of isotopes to be extended to other chemical elements. Professor Klaus Clusius, of the Institute of Physics and Chemistry at Munich, has recently obtained the isotopes of chlorine 99.4 per cent. pure. A modification of the Clusius method has been developed by the American scientists. Describing their method they said: "The separation tube consists of two concentric glass tubes placed in a vertical position, the inner tube being heated electrically to several hundred degrees Centigrade and the outer tube cooled. The net result of the gas motions occurring within the tube is that the light molecules are concentrated at the top of the tube and the heavy at the bottom. With this inexpensive and comparatively simple thermal device, marked separations of mixtures of gases have been obtained. It has been possible to obtain oxygen from air over 80 per cent. pure. The separation of the isotopes has been demonstrated; even for such heavy elements as chlorine where other methods are impractical the isotopes have been highly concentrated."—ROBERT D. POTTER.

FURTHER WORK WITH SULFANILAMIDE DERIVATIVES

CURE of tuberculosis, leprosy and influenza by chemical derivatives of sulfanilamide, medicine's new weapon against a wide variety of streptococcic infections, is a new hope offered to-day as a promise of intensive chemical research now under way.

Reported at the meeting of the American Chemical Society were studies which foreshadow such possibilities, spurred by the success with sulfanilamide. Dr. M. L. Crossley, research director, and E. H. Northey and Martin E. Hultquist, of the Calco Chemical Company, described their new discoveries, emphasizing that it was only preliminary work which offered no cures at the present time. They said: "Of the many compounds prepared, the compound N-one-dodecanoyl-sulfanilamide is the most outstanding. This compound can be pictured as a combination of sulfanilamide with part of a fat. It has the properties of both its parents in that it pene-

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By M. deK. Thompson. Third Edition to be ready in May. $5.00 (probable)

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By H. H. Newman. $3.60

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Biology of The Vertebrates

By H. E. Walter. Revised Edition to be ready in May. $4.00 (probable)

The new edition of this text provides a full course of study on the vertebrates, outstanding for its effective organization of material, its interesting style of presentation, and the inclusion of a liberal amount of useful background information.

Elements of Plant Pathology

By I. E. Melhus and G. C. Kent. To be published in May. $4.50 (probable)

The excellent choice of material, the unusually effective and interesting presentation, and the unique illustrative equipment all combine to make this new book the outstanding text on the market for introductory courses in plant pathology. Attention is focused on parastism—on living organisms in disease processes. The individual diseases discussed are widely representative. 258 diagrams and photographs—most of them original—illustrate the book.

Macmillan, New York

trates the fatty tissues of the body carrying the therapeutic properties of the sulfanilamide. In studies on experimental animals it has shown a definite superiority to sulfanilamide in treating streptococcic infections and tuberculosis. The preliminary tests on animals carried out by Dr. David R. Climenko in the division of pharmacological research of the Calco Chemical Company have shown the dodecanoyl product to be of a low order of toxicity in comparison with sulfanilamide.''

Massive doses of human tubercle bacilli injected into experimental guinea pigs produced only small local lesions at the site of the injection instead of generalized manifestations of the disease throughout the body. It has also been shown that low concentrations of the new sulfanilamide derivative inhibit the growth of the tubercle organisms, for 90 days in test tube experimental cultures.

A characteristic fact about the new form of sulfanilamide is its fat solubility. Tentatively it is suggested that this property may aid the drug in penetrating the fatty, waxy pellicle which surrounds the tubercle bacillus and which makes it impervious to many chemotherapeutic agents.

The drug does not cure tuberculosis in animals but rather acts to arrest the spread of the infection and localizes it at the site of entry of the tubercle bacillus. The tubercle bacillus is one of a group known as acid-fast organisms. The organism causing leprosy is another. ''In view of the promising results obtained with this drug in the treatment of experimental tuberculosis, it is suggested, and attempts will be made to demonstrate this experimentally, that the drug may be equally effective in the treatment of other diseases caused by the acid-fast bacilli, such as leprosy.''

Last year the same investigators reported other sulfanilamide derivatives which offered promise of curing virus diseases, in particular, influenza.

''The above dodecanoyl-sulfanilamide is but one of a large number of products studied in the comprehensive investigations in progress in these laboratories. It is hoped that out of this study will come effective therapeutic agents for the alleviation of disease.

''These preliminary results in animals do not in any way permit any conclusion at the present time as to their efficiency in the treatment of diseases in man. Further study is in progress and the results will be reported later.''

The Calco Chemical Company, where these findings have been obtained is—with the Monsanto Chemical Company—the nation's largest producer of sulfanilamide drugs. The drugs are sold in bulk to the various drug houses where they are packaged and sold to druggists and physicians.—ROBERT D. POTTER.

THE VITAMIN CONTENT OF MILK

PROFESSOR DAVID B. HAND, of the New York State College of Agriculture at Cornell University, reported to the American Chemical Society that making a vitamin in milk glow to a brilliant green color is the newest feat of science in estimating milk's content of this important dietary chemical known as riboflavin.

Riboflavin is the green coloring matter of milk whey. When blue light shines on the whey the riboflavin turns intensely green by fluorescence. By observing the intensity of the green light, the content of the riboflavin present can be measured. Previously it has been necessary to feed whey to animals and wait for them to grow measurably.

Sunlight is bad for milk, Professor Hand continued, because it causes the rapid destruction of vitamin C, which aids in preventing scurvy. Milk fresh from the cow has a good supply of vitamin C but by the time it is bottled and delivered most of the vitamin C content is gone.

Professor Hand and his colleagues, Paul F. Sharp and E. S. Guthrie, of Cornell University, have found that it is the presence of vitamin G in milk which accounts for the destruction of vitamin C by light.

''It seems strange that one vitamin should cause the disappearance of another,'' Professor Hand said, ''but it should be remembered that this only happens in the light and milk was never intended in nature to be exposed to light. Air or oxygen also takes part in the destruction of the vitamin C. The vitamin is stable if all dissolved air is removed from the milk.''

Scientists at Cornell University have developed methods for bottling milk in a vaccum so that it may still possess vitamin C when delivered to the consumer. Fresh milk contains enough vitamin C for each quart to suit the requirements of an average person per day.—ROBERT D. POTTER.

THE FORMATION OF NEBULAE

AN expanding universe has decreed that no more of the great star clusters or nebulae which dot the heavens are to be born. The bulk of the stars were formed inconceivably long ago by condensation from huge gaseous clouds of matter. The stars then grouped together to make the nebulae, in a universe whose linear dimensions were then 600 times smaller than they are to-day. Matter is spread too thin throughout the expanded universe now to make such star cluster formation possible any longer. These are the conclusions of Drs. George Gamow and Edward Teller, of the George Washington University, presented in a paper printed in *The Physical Review*.

Above a certain critical density value for matter in gaseous clouds, stars are formed by gravitational condensation. But that value has long since been passed as the nebulae, fleeing apart at enormous speeds, have spread out the universe's content of matter. The nebulae may be spreading apart in a space which is open, not closed as many previous universe theories indicate.

Previous theories have held that, because distant nebulae appeared more luminous, space closes in on itself. But this brightness may be due to the fact that the nebulae, which are so distant that it is usually impossible to see the separate stars of which they are made up, may be more compact in the earlier part of their existence. Because of the hundreds of thousands of years it takes light from them to reach the astronomer's giant telescopes, what we see to-day actually represents an earlier period of their existence.

Space is infinite and ever expanding, Drs. Gamow and Teller also conclude. Otherwise, they assert, it is impossible to account in this fashion for the formation of the great nebulae. The nebulae separated from each other about 1.8×10^9 or 1,800,000,000 years ago, it is calculated. The bulk of the stars were formed before that time and event.

STORING THE SUN'S ENERGY

STORE the now-wasted surplus sun-energy in underground silos as trapped heat, to be drawn out and used as needed, is the proposal of Dr. F. G. Cottrell, of Washington. Dr. Cottrell's suggestion is incorporated in a new report by Dr. Charles G. Abbot, secretary of the Smithsonian Institution, in which latest developments of Dr. Abbot's many years of research on direct utilization of sun-power are discussed.

The "solar-silo" scheme is exceedingly simple. There would be a deep, cylindrical, concrete-lined pit, filled nearly to the top with loose, dry sand, and "stoppered" with about ten feet of glass wool, an excellent heat insulator. To the top of the sand would run a branched inlet pipe, from a solar heater, of the focussing mirror type invented by Dr. Abbot. An automatically controlled pump would bring in heated air when the sun was shining, and stop at night or in cloudy weather. A second set of pipes, at the bottom, would draw off the heated air as needed. It is believed that the sand, under its thick blanket of glass wool, would retain its high initial temperature for perhaps many months.

Dr. Abbot's latest improvement in the solar heater itself has been an automatic control of the water-stream flowing through it, to be converted into steam by the mirror-focussed rays of the sun. It is now arranged to take in water more rapidly as the boiler becomes hotter, and to cut it off when lack of sunlight reduces available heat.

Another adaptation by Dr. Abbot of the solar heater principle is the development of a solar water distiller, for use in deserts, on remote islands and in other places where the natural water is unfit to drink. It makes it possible to produce safe, potable, odorless water at very low expense.

ITEMS

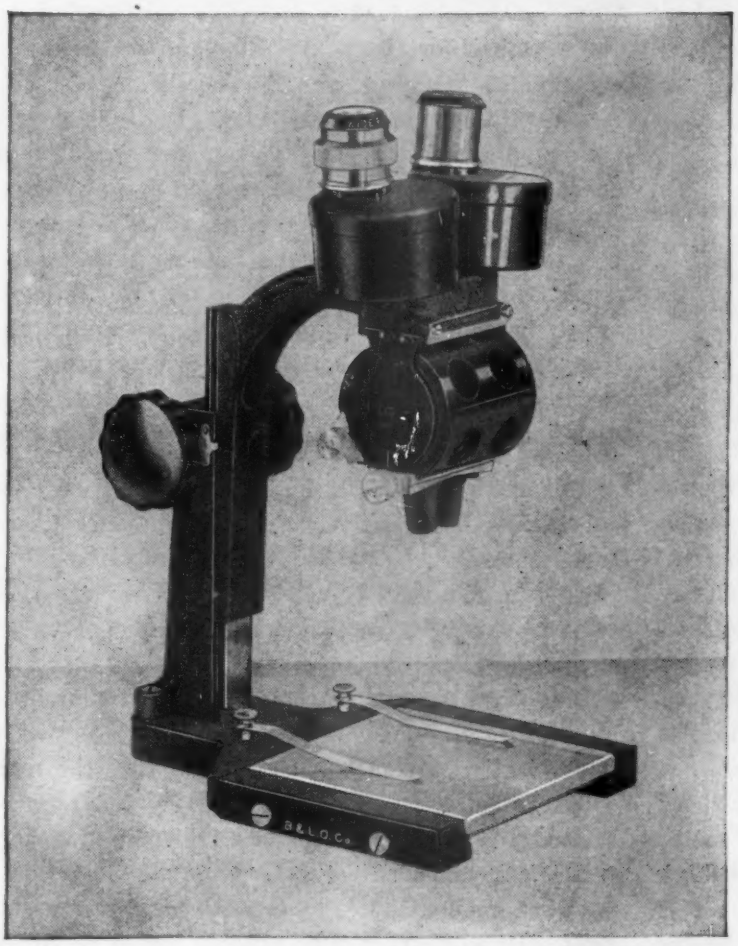
NEUTRONS emitted during the splitting of uranium—a process which releases enormous amounts of energy and leads to formation of elements whose atomic weights are fractions of that of uranium—have been traced by investigators of the Carnegie Institution of Washington to the radio-active products of uranium's decomposition, according to an article published in *The Physical Review*. Additional products of the uranium decomposition, which has attracted enormous attention, are also reported in the same issue. According to Dr. Philip Abelson, of the University of California, radio-active antimony, tellurium and iodine have been identified. The four Carnegie scientists who found the source of the neutrons are Drs. R. B. Roberts, L. H. Hafstad, R. C. Meyer and P. Wang.

THE Works Progress Administration in thirty-one months of actual activity has aided educational activities by constructing enough school buildings to put a new one in every one of the 3,000 counties of the United States, according to a summary report of the work relief administration's activities by Administrator Col. F. C. Harrington. Its health activities have included 15,000,000 examinations, immunizations and treatments of medical, dental, nursing and household assistance nature. Seven million visits were made to 1,000,000 families. Other public health activities included extensive drainage operations to eliminate malaria mosquito-breeding areas. Sewage disposal projects, ranging from elementary facilities to disposal plants, have been systematically carried out. Conservation activities have also figured prominently in the program, Col. Harrington pointed out. Erosion control and transplanting projects protecting thousands of acres have been executed. Hundreds of abandoned mines have been sealed to prevent stream pollution.

TEACHING deaf children to talk by use of shorthand, a method devised by Alexander Graham Bell, has at last been vindicated by science. "Entirely feasible," is the verdict pronounced by Dr. Max F. Meyer, of the University of Miami, as a result of experiments on half a dozen children. The method, as proposed by Bell, was first to teach the reading and writing of shorthand words, unabbreviated, then the pronunciation of such words, phonetically written, and only after that the reading and writing of ordinary English. "Fifty years ago, it was," related Dr. Meyer, "when Bell hired a teacher for his small experimental school, but she had not enough patience to continue the experiment for more than one year. In so short a time nothing could be proved. The professional teachers of the deaf ever thereafter scorned Bell's idea, saw nothing good in it. They meted out the same scorn to me when, ten years ago, I began to revive Bell's idea. They even refused to let me announce it in the very *Volta Review* which Bell founded and endowed to spread the teaching of speech to the deaf."

MATHEMATICAL tables highly useful in the theory of relativity calculations are now being computed by the Works Progress Administration for the City of New York. The highly intricate and tedious task is part of the general project on computing mathematical tables sponsored by Dr. Lyman J. Briggs, director of the National Bureau of Standards. In charge of the New York project is Dr. Arnold N. Lowan who, during his graduate studies, worked at the Institute for Advanced Study in Princeton, N. J. Among the projects completed is a table of exponential functions computed to approximately 15 decimal places, and a table of the first ten powers of the integers from 1 to 1,000. The complex tables, worked out by a skilled staff on giant calculation machines, will have inestimable value for mathematicians and other scientists for years to come. Some of the tables have never before been worked out to such exactness.

POTATO beetles are firmly entrenched in Continental Europe, but have not yet succeeded in crossing the narrow seas to Britain. The English Government has placed restrictions on the importation of potatoes and several other vegetables from the Netherlands, which might carry the eggs or pupae of the destructive insects.



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SCIENCE NEWS

Science Service, Washington, D. C.

THE UNIVERSAL VITAMIN

ONE vitamin out of the whole alphabet of them is probably essential for the growth of all living things, from bacteria, fungi, seed plants and similar lowly forms to the higher animals and possibly man himself. Two new discoveries which indicate that there probably is such a universal vitamin appear in reports to the *Journal* of the American Chemical Society. At the same time partial synthesis of the vitamin is reported.

The vitamin is part of the large group of B vitamins, which include the anti-beriberi vitamin, thiamin, the anti-pellagra vitamin, nicotinic acid, and riboflavin. The universal vitamin is called pantothenic acid, its Greek name indicating that it is found everywhere. This vitamin was first discovered by Professor R. J. Williams (brother of Dr. R. R. Williams, who synthesized another vitamin, B_1 or thiamin) and associates at the University of Oregon, who found that it stimulates the growth of yeast.

The latest discoveries, indicating that this vitamin promotes growth of chicks, are reported by two groups of experimenters, Dr. Thomas H. Jukes, of the University of California, and Drs. D. W. Woolley, Harry A. Waisman and C. A. Elvehjem, of the University of Wisconsin. Dr. Elvehjem is the chemist whose studies of nicotinic acid led to its becoming the cure for pellagra.

Dr. Jukes reports that a preparation of pantothenic acid (calcium pantothenate) protected chicks from a dermatitis which develops when they are on a diet lacking in part of the vitamin B group called the filtrate factor. Dr. Elvehjem and associates report partial synthesis of this filtrate factor which their chemical studies show is very similar to pantothenic acid. "Final proof of the identity of the two," they state, "must await crystallization of the pure compound."

Professor Williams, discoverer of pantothenic acid, from his new post as professor of chemistry at the University of Texas, points out in a statement to Science Service:

"Since its discovery it (pantothenic acid) has been found to be not only present in widely different tissues and organisms but to function as a potent physiological substance stimulating the growth of yeasts, molds, lactic acid bacteria, diphtheria bacillus, protozoa, young alfalfa seedlings and liverworts, and to stimulate the respiration of various tissues.

"The present discovery of Jukes and of Woolley, Waisman and Elvehjem is the first one linking it up definitely as a 'growth-promoting substance' for higher animals, though it has been recognized as a constituent of all types of animal tissue and to be stored in the livers of all animals.

"Too great significance should not be placed upon the fact that chicks are the experimental animals used in these first experiments. There is evidence that the same substance is required by pigs and dogs and the inference is not a wild one that it is necessary for the nutrition of all the higher forms of animal life and that it makes u an essential part of every living cell.

"One of the interesting features regarding this di covery is that it demonstrates anew the kinship of th whole organic world, since the lowly microscopic yeast ce requires for its nutrition the same substance as is require by higher animals. Pantothenic acid is produced b various molds and microorganisms in the soil and else where and by green plants after they develop their photo synthetic apparatus.

"Not all of the vitamins seem to be as universal in thei function as pantothenic acid. Yeast which is typical o the lower plant life apparently does not contain vitamin A vitamin D, vitamin E or vitamin C, unless especial mean are taken (such as irradiation with ultra-violet light) t place them there. It seems probable that these vitamin may not be essential to all forms of life. Vitamin B and nicotinamide, on the other hand, like pantothenic acid are probably universally present in living matter."

THE FEMALE SEX HORMONE EQUILENIN

THE total synthesis of the female sex hormone equilenin —an important new advance in the chemistry of sexua activity in women—is announced by chemists of the Uni versity of Michigan. Reporting to the *Journal* of the American Chemical Society, Professor W. E. Bachmann Wayne Cole and A. L. Wilds state:

"Although certain sex hormones such as estrone hav been prepared from other naturally occurring compounds possessing similarities in structure, the total synthesis of none of them has yet been reported. We have now suc ceeded in accomplishing the total synthesis of the sex hor mone equilenin."

Following closely the discoveries of Professor Russell E Marker, of Pennsylvania State College, that equilenin can be converted to estrone by reduction, the new research means that the total synthesis of these highly important sex hormones has now been accomplished.

Equilenin, chemically related to the sex hormone theelin found by Professor Edward A. Doisy, of St. Louis Uni versity School of Medicine, was reported by Drs. Andre Girard and Georges Sandulesco, of the Roussel Research Laboratories, Paris, in 1932. Its name was given because it was first found in the urine of pregnant mares. Several tons of this material had to be used, in these early experi ments, to extract about three grains of the hormone.

EFFECT OF PARENTAL DIET ON THE SEX OF OFFSPRING

THE discovery that the sex of offspring can be deter mined by the diet of the parents, at least in rats, may explain why more boy babies are born after wars.

Dr. Frederick Hoelzel, of the University of Chicago, pointed this out in commenting on sex determination find ings just announced by himself and two other University of Chicago scientists, Dr. Esther Da Costa and Professor A. J. Carlson.

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Just off the Press—

Recent Advances in Surface Chemistry and Chemical Physics

PART I

Applications of Surface Chemistry to Biology.—Papers by Drs. Irving Langmuir, William D. Harkins, L. H. Germer, Harry Sobotka, and G. H. A. Clowes. The results reported give promise that the investigations of the properties of unilayer and multilayer films will lead to an explanation and understanding of the processes of exchange of materials through the surfaces of living cells.

PART II

Recent Advances in Chemical Physics.—Papers by Drs. Harold C. Urey, J. Y. Beach, Merle Randall, H. Sponer, James H. Hibben, and Albert Sherman. Contributors take up fundamental questions respecting the structure and properties of elements and compounds. The whole problem of the separation of the isotopes of the elements is comprehensively treated, both experimentally and theoretically.

Publication Committee:

Farrington Daniels, *Chairman,* Neil E. Gordon, Harold C. Urey.

133 pages; 58 illustrations. **Cloth binding, $2.50**

Published for

The American Association for the Advancement of Science by The Science Press, Lancaster, Pa.

Feeding a high protein diet to male rats and a low protein diet to the females led to a ratio of 145 males to 100 females in the offspring. Reversing the diet reversed the sex ratio to 92 males to 100 females. Protein appears in the human diet in the form of meat, cheese and eggs.

"It is too early to say whether diet could be used to practical advantage to control sex in animal breeding," Dr. Hoelzel replied to a Science Service inquiry. "Our results, however, may mean that the greater number of boy babies, particularly after some wars, are due to the fathers obtaining a higher proportion of protein in the diet than the mothers. The most significant suggestion from our results seems to be that the 30 to 40 per cent. of abortions or resorptions of fetuses that are known to occur in domestic animals and humans may be serving an important rôle in evolution by eliminating the least fit at this early stage of life."

The effect of diet on the sex of offspring is explained on the grounds that the state of protein metabolism induced in the parent by high or low protein diet evidently also affects the germ cells and tends to determine the survival value of the same sex among the embryos.

THE ROTATION OF MOLECULES INSIDE SOLIDS

USING the electrical property as the dielectric constant, it can be determined whether molecules inside solids are rotating, according to a report made to the New York Academy of Sciences by Professor Charles P. Smyth and Dr. William O. Baker, of Princeton University. "It had previously been known that molecules in solids vibrate in very short paths about points in a rigid lattice and measurements on specific heats had indicated, in a few solids, that the molecules begin to rotate as the temperature rises. The dielectric constant measurements provide a means of reaching into the material, taking hold of any positive and negative electricity on opposite sides of the molecule, and learning whether it can turn. A number of molecules have been found to turn as easily in the solid as in the liquid until falling temperature reduces their energy so far that they rather suddenly cease to turn."

Professor Smyth pointed out that whether molecules in a solid rotate or not depends on their ability to overcome orienting forces by their heat energy. These inner molecular forces play a part in determining at what temperatures a substance will boil or melt, and may cause a liquid to form a glass on cooling while another almost similar compound solidifies directly into a crystalline form.

Measurements of the dielectric constant——an index of a material's ability to withstand electric strain as in electrical glass insulators—are used to calculate the energies necessary for the rotation of molecules in the glasses. Substances whose molecules will rotate in the solid crystalline state are found to have higher melting points and exist as liquids over a shorter range of temperatures than do similar substances with non-rotating molecules.

PAN AMERICAN AIRWAYS TRANS-ATLANTIC SERVICE

PAN AMERICAN AIRWAYS' application to the Civil Aeronautics Authority for mail payments for the transatlantic air service it will inaugurate shortly will probably be cut by the authority to three fourths or even only three fifths of the requested amount. Payments which will cost the U. S. Government a net ranging from about $10,000 per round trip for four return crossings a week, or a gross from about $24,000 up, are asked by the airline in a hearing before a three-man board of the authority.

A gross annual payment of $5,000,000 to $5,750,000 is asked by the line if four services a week are authorized. But this sum, which PAA insists is necessary to enable a return on the $1,500,000 spent thus far in Atlantic development work, is regarded by informed people in the government aviation body as excessive. At twenty-five cents a half ounce, users of transatlantic airmail would repay the government $3,320,000, leaving a net annual payment out of Treasury funds of $2,455,000 if four services a week are operated and the line's request for funds is granted in full. Not only will the annual payment by the government probably be held below this total, but the subsidy per trip will, in all likelihood, be reduced as well.

Eventual operation of four services a week may be authorized at the conclusion of the present hearing, but it is unlikely that they will be maintained at any time during the first year of service. But because overhead cost is constant and passenger, cargo and mail revenue decreases faster than the number of trips, it is possible that fewer trips will cost the government more per year. In any event, the scale will in all cases be lower than that filed by the airline.

Estimates of passenger traffic filed by the Pan American are believed to be too low—barring a European war, of course, in which case almost any passenger traffic estimate is too high, unless the United States is a participant. The financial schedules of the line include this allegedly low estimate.

In the case of the airline's application a month ago for an increase of its postal subsidy on the transpacific route, Pan American was criticized for high-engine overhaul costs and a number of other expenditures. The authority is likely to look closely into similar estimates prepared for maintenance of its transatlantic planes and ground facilities.

THE HYDROGENATION PROCESS OF TREATING PETROLEUM

THE chemical process of high pressure hydrogenation—by which Germany to-day makes nearly half of her gasoline—has been applied in the United States to petroleum with yields of one and one fifth gallons of gasoline for each gallon of oil.

This yield, the highest ever attained by any process of treating petroleum, was reported to the meeting of the American Section of the Society of Chemical Industry and the New York Section of the American Chemical Society by Dr. W. J. Sweeney, of the Esso Laboratories of the Standard Oil Development Company. Hydrogenation will become extremely important, Dr. Sweeney stated, when estimated United States supplies of crude oil reserves show signs of shrinkage. At present the method is not used

commercially. A hundred octane gasolines, high-powered low-knocking fuels for military and transoceanic airplanes, are now available commercially.

Among the newest advances is the process of "alkylation." This is a catalytic type of reaction in which a fragment of a hydrocarbon is hooked on to a gasoline molecule in place of one of its hydrogen atoms. This creates a "fishlike" molecule which burns slower than ordinary gasoline molecules and hence has a lower knocking value and higher octane rating. Experimentally such gasolines have been created with an octane number of 125, according to reports to the American Chemical Society. Fifty per cent. more power than present 100-octane aviation fuels is claimed for this new gasoline.

Modern technological advances in petroleum chemistry have greatly extended the estimated life of America's known petroleum reserves. In the early days of the automobile crude petroleum was distilled for its gasoline content and virtually all the rest of the vapors rejected and discarded.

Next it was found that crude oils could be "cracked" by heat and pressure to increase their yields of gasoline. Then, as the demand for higher octane gasolines increased, the process of polymerization came into being. Finally has come alkylation making gasoline even better and with even higher yields.

It is estimated that $100,000,000 has been invested in new refining plants for the petroleum industry and that when these are all in operation the more efficient processes will save the United States 500,000,000 barrels of oil a year, or about half the nation's present yearly consumption. In other words, modern petroleum technology effectively doubles the nation's oil reserves.

ITEMS

CONCRETE walls can be used to shield against penetrating x-rays used in hospitals for treating cancer instead of lead, with resultant economies in the cost of protecting patients and doctors, has been found by studies made at the National Bureau of Standards. The cost of protection for installations as powerful as 400,000-volts may be cut 90 per cent., and, for 200,000-volt machines, by 80 per cent. according to Lauriston S. Taylor, in charge of x-ray investigations at the bureau. The present International Recommendations for X-ray Protection are at times unnecessarily stringent, Mr. Taylor finds. Concrete walls and floors, if thick enough, provide adequate protection. The economies now possible are important because lead walls contribute a major part of the cost of installing x-ray apparatus.

BEARS seem to have disappeared from the Alps, at least from the western and central portions, where they were once abundant. A recent close search of the heights of the Vercors range in the French Alps, formerly a favorite stamping-ground of brown bears, failed to turn up a single bear or any trace of one. The last record of a bear killed in the Vercors mountains is dated 1896, and the last time a bear was seen was in 1921. Supposed traces of bears have been reported up to 1937, but these are rather uncertain.

POTATOES are being tested for quality at the New Hampshire Experiment Station at Durham. They are thrown into a series of salt brines of different densities. The poorest ones float in the thinnest brines, while the best spuds, which are firm and heavy for their size, sink to the bottom in even the thickest salt solution used. It has been found that the cooking qualities of potatoes vary directly as their specific gravity, as determined by the brine-bath tests.

IT is reported that low-grade ores containing silica, which is difficult to remove, are giving engineers in charge of building blast furnaces for the Hermann Goering Werke iron and steel combine headaches and are causing delays in a construction program vital to the success of the Four Year Plan to make the Reich independent of foreign supplies. When and if the new furnaces are completed and placed in operation, production costs will run to considerably more than double those in other large iron producing plants. A new method of removing silica from the iron as it comes from the furnaces, known as the Brassert process, may have to be abandoned in favor of other methods. The furnaces are located near the ore bodies in Brunswick they are intended to exploit. In addition to having a high silica content, contained iron is only 30 per cent. as compared with 60 per cent. for Swedish ore.

TELEVISION and aeronautical radio will be given a great impetus by the invention of the "klystron" ultra-short-wave radio apparatus at Stanford University. It sends and receives on wave-lengths as low as 10 centimeters (4 inches) at efficiencies not hitherto attained. It is hailed as "the most important advance in radio since the invention of the audion tube in 1906 by Lee de Forest." Invented by Russell H. Varian and developed by a Stanford group, including Varian, his brother, Sigurd F. Varian, Professors William W. Hansen and David L. Webster, the klystron grew out of the rhumbatron, an electric resonator intended to smash the atom. Flight-Captain Sigurd Varian was a Pan-American Airways pilot when he visualized that the rhumbatron, developed by Professor Hansen, could be applied to radio communication for airplanes. Taking leave of absence, he organized the Stanford group for the research which is now successful. Two rhumbatrons, called the "buncher" and the "catcher," form the heart of the klystron, so named from the Greek "klyzo," meaning waves breaking on a beach, which is what the apparatus does.

SIR FRANCIS DRAKE'S famous plate of brass, on which he claimed the California coast as a kingdom for England, has definitely been found, according to the result of six chemical tests given to the piece of now battered metal. The tests close a heated controversy as to whether or not a brass plate picked up on the California shore, several years ago, is a historic American document or a hoax. Professor Colin G. Fink and E. P. Polushkin, of the Electrochemical Laboratories of Columbia University, put the engraved metal object through a series of tests at request of the California Historical Society. They report, "it is our opinion that the brass plate examined by us is the genuine Drake Plate referred to in the book, 'The World Encompassed' by Sir Francis Drake, published in 1628."

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BAUSCH AND LOMB OPTICAL COMPANY, Rochester. *Bausch and Lomb Magazine, Vol. XV, No. 1.* Pp. 23. Illustrated.

BELL, G. AND SONS, LIMITED, London. *Bell's Miscellany; a List of Books to be Published during Spring, 1939.* Pp. 33.

BURROUGHS WELLCOME AND COMPANY, INCORPORATED, (U. S. A.) New York. *"Tabloid" First-Aid for Industry.* Pp. 49. Illustrated.

CENTRAL SCIENTIFIC COMPANY, Chicago. *Cenco News Chats, No. 23, April, 1939.* Pp. 23. Illustrated.

EDWARDS, W. AND COMPANY, London. *Diffusion Pumps for the Production of High Vacua.* Pp. 16. 17 figures.

FELLER, GUSTAV, Neubrandenburg, Germany. *Faunisticher Führer durch die Coleopteren-Literatur; Band I, Europa.* Pp. 33–128. *J. Chr. Fabricius Systema Glossatorum (Brunovici, 1807).* Pp. VII–XI. *Naturwissenschaftliche Neuerscheinungen.* Pp. 12.

GAUTHIER-VILLARS, Paris. *Bulletin des Publications Nouvelles (2me Semestre, 1938).* Pp. 15.

GOLDSCHMIDT, E. P. AND COMPANY, LIMITED, London. *Catalogue 51, History of Science and a Few Rare and Important Old Medical Books.* Pp. 76. Illustrated.

OXFORD UNIVERSITY PRESS, New York. *Bulletin of New Publications, February and March, 1939.* Pp. 16. Illustrated.

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SCIENCE NEWS

Science Service, Washington, D. C.

SOME PAPERS READ BEFORE THE AMERICAN PHILOSOPHICAL SOCIETY

COSMIC rays strike the outermost parts of the earth's atmospheric envelope at the terrifically high energy level of six billion electron volts, Dr. Robert A. Millikan, of the California Institute of Technology reported. This figure is based on records of instruments sent aloft in small, unmanned balloons that penetrated the stratosphere and went on up until only one or two per cent. of the atmosphere remained above them. "This maximum corresponds closely to the energy to be expected if there is a possibility of transforming into cosmic-ray energy the whole of the rest-mass of the carbon atom," Dr. Millikan explained. "This is the most abundant element save hydrogen and helium which the spectroscope, in Dr. Bowen's hands, has revealed in the nebulae."

MESOTRONS, recently discovered welterweight atomic particles which are intermediate in mass between heavyweight protons and lightweight electrons, are abundant in nature, but in a part of the outdoors that few of us ever get to—the upper air above 25,000 feet, Professor Arthur H. Compton, of the University of Chicago, reported this morning before the meeting here of the American Philosophical Society. Instruments for detecting and counting these particles were exposed at sea level, on mountain heights and in a high-flying airplane by several of Professor Compton's associates. At sea level and up to 14,000 feet, he said, mesotron production is almost non-existent. At 20,000 feet it is readily observable, and at 25,000 feet it is abundant.

Calculations based on observations at accessible altitudes indicate that greatest mesotron production goes on close to the very top of the atmosphere. At this level, the mesotrons are produced by bombardment of atmospheric molecules by incoming cosmic rays. At lower altitudes, Professor Compton stated, photons (particles of light) and secondary cosmic rays are responsible. The mesotrons thus produced in the upper levels of the atmosphere disintegrate into smaller particles by the time they reach the levels at which men live. Among those associated with Professor Compton in these researches were Drs. Volney Wilson, Marcel Schein, D. S. Hsiung, F. R. Shonka and P. S. Gill.

MEASUREMENTS of the rotation of the sky's most famous giant pinwheel, the great spiral nebula in the constellation Andromeda, were reported by Dr. Horace W. Babcock, of the Lick Observatory, University of California. This object is really a vast mass of stars and star-stuff on the order of 50,000 light-years in diameter, so that it makes a really massive wheel. In its spinning, Dr. Babcock said, the parts near the center and the parts near the rim move at nearly the same angular rate, just as a point on the hub and one on the tire of a wheel always keep opposite each other. This means of course that the linear velocity, the speed in miles per hour, is vastly higher in the outer parts of the nebula than it is near the center. The "arms" of the nebula are spirally curved, and Dr. Babcock found that movement is in the direction of the convex curvature. Dr. Babcock also made an approximate calculation of the amount of material in this nebula. It amounts to 10^{11} or 100,000,000,000 times the mass of the sun.

DR. CHARLES B. DAVENPORT, of Cold Spring Harbor, N. Y., called attention to the fact that we change the shapes of our own skulls, giving our heads different forms as we grow up, according to the predominating activities of the various "ages of man" through which we pass. Dr. Davenport has spent many years in the application of the principles of genetical science to problems in human eugenics. The process begins even before birth, when the skull becomes longer and narrower just before it must make its crucial journey through the birth canal. In early infancy, while it is still only a series of slightly bony plates embedded in flexible cartilage, it shapes itself more broadly as it lies in the crib. Yet children born invalids and condemned to lie in bed all their lives do not keep this crib-influenced skull shape, but eventually acquire nearly standard head proportions. "As soon as the infant begins to walk," Dr. Davenport continued, "the head height diminishes or increases only slowly under the pull of gravity, but after one and one-half years the vertical dimension increases rapidly as though to compensate for the earlier loss. During the period of great activity in jumping and romping the vertical dimension of the head grows very slowly. The length of the skull grows relatively faster in adolescent boys than in girls."

"BLOOD relationship" is no mere figure of speech; it really means something. This has been indicated in researches reported by Professor Merkel H. Jacobs, of the University of Pennsylvania. Professor Jacobs has devised a simple and quick method for testing the ability of blood corpuscles of widely different species of animals to absorb various kinds of chemicals, requiring no apparatus other than test-tube and stop-watch. He finds that corpuscles of related species resemble each other more in their characteristic absorbing powers than do red cells from animals more widely separated in their kinship. He has worked out a "key" for their identification, similar to that used by systematic botanists and zoologists.

COLCHICINE, old-fashioned rheumatism remedy that has recently been used with spectacular results to speed up evolutionary changes in flowering plants, met its Waterloo at the bottom of the vegetable life ladder, Dr. Albert F. Blakeslee, of the Carnegie Institution of Washington, reported here this afternoon before the meeting of the American Philosophical Society.

Colchicine works on the higher plants because it is poisonous to them. It causes a doubling of their chromosome numbers by partially paralyzing the cell-division

NEW WILEY BOOKS

Published Spring 1939

PROCEEDINGS OF THE SIXTH SUMMER CONFERENCE (1938) ON SPECTROSCOPY AND ITS APPLICATIONS

Edited by GEORGE R. HARRISON, *Professor of Physics, Massachusetts Institute of Technology*

This volume contains, in somewhat abbreviated form, the thirty-one papers which were presented during the three days of the 1938 conference on spectroscopy and its applications. Although space limitations decreed that not much more than half of the orally presented material be included, the condensations have been carried out by the respective authors, and little essential material has been neglected. The volume constitutes an important compilation of discussions of a rapidly developing field from various aspects.

179 pages; 91 illustrations; 7½ by 10; $3.00

METHODS OF STATISTICAL ANALYSIS

By C. H. GOULDEN, *Honorary Lecturer in Statistics, University of Manitoba*

A well-balanced, concise presentation of statistical methods for research work. The book is designed for the use of those who have studied as a prerequisite a moderate amount of general theory and principles. It will be particularly useful for students intending to specialize in biological research. A series of actual examples covering a wide scope is given. The first half of the book is written so that, in reviewing, the student is brought into contact immediately with the structure of actual experiments. The later chapters present a well-illustrated discussion of the application of statistical principles and methods to the designing of experiments and the analysis of results of the experiments so designed.

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Second Edition **530 pages; 526 illustrations; 6 by 9; $6.00**

TRIGONOMETRY

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This book is intended for use in a first course in trigonometry for students in the freshman year in college. The solution of triangles has been placed early in the text, while analytical trigonometry has been placed later. Features of especial importance are: the early introduction of the definitions of the trigonometric functions; the rather complete discussion of approximate numbers; the chapter on logarithms; the brevity of the individual articles; the large number of exercises; the illustrative examples; the teachability and flexibility of the book.

Text, 189 pages; Tables, 79 pages; 95 illustrations; 5⅝ by 8⅝; With tables, $2.00; Without tables, $1.50

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process. The only higher plant found to be immune to this poisoning effect is the plant from which the drug is derived, Colchicum, the autumn-flowering crocus.

Dr. Blakeslee, with Drs. Sophia Satina and Marie E. Conklin, used colchicine on several kinds of molds and bacteria, as well as on some of the liverworts or lower mosses, and on certain algae or pond-scum plants. It apparently had effect on the latter two groups, which are green or chlorophyll-bearing plants. But the molds and bacteria would not change their way of life for it. Indeed, two species of mold and one strain of bacteria apparently found it good for food.

DEGREE of dryness in soil, as expressed in its ability to take up offered water and transmit it for short distances, is automatically measured by apparatus described before the meeting by Professor Burton E. Livingston and Stuart B. LeCompte, Jr., of the Johns Hopkins University. The instrument consists primarily of an inverted cone of porous porcelain, permanently buried, and supplied with water from a reservoir at the top. As long as the soil is not saturated, it keeps drawing water away from the cone, the rate depending on the degree of dryness. As soon as saturation sets in, the instrument stops working, to resume operation when the soil once more begins to dry out.

Dr. Livingston also described two instruments, one of them his own invention, that give expressions of the total intensity of sunlight.—FRANK THONE.

PLANT TISSUE GROWN IN TEST TUBES

PLANT tissue that is neither root, stem nor leaf, but "just plant," is kept growing in test tubes at the Rockefeller Institute for Medical Research laboratories in Princeton, N. J., by Dr. Philip R. White. Potentially immortal, these masses of plant cells can be made to develop and differentiate into small plants at the will of the experimenter. At a recent meeting of the Torrey Botanical Club Dr. White described his technique and its results.

The principles would apply to any of the higher plants; the actual species used by Dr. White are tobacco and tomato. The outer layers of the stem are peeled away, and a conical piece broken out of the growing tip. All the work is done under aseptic conditions, for the presence of bacteria or fungi would quickly cause decay and destroy the cultures.

The bits of stem-tip tissue are placed on a mixture of mineral and organic nutrients solidified into a jelly with agar. They develop outgrowths of cell masses, that can be cut off and re-propagated in the same way, indefinitely.

So long as these cell-mass cultures are kept on the nutrient agar jelly they continue to grow as undifferentiated tissue—stuff that is "just plant." But if they are taken off the jelled substratum and dropped into a liquid solution containing the same food substances they sink to the bottom and presently produce first stems, then leaves and roots—complete plantlets.

Why these masses of generalized plant cells should be induced to turn into differentiated and specialized stem, leaf and root tissues by being thus immersed, Dr. White said that he was unprepared to state positively. He conjectured, however, that the difference between the oxygen supply at the top and at the bottom of the solution may have something to do with it.

These masses of plant tissue have been kept growing for eighteen months, divorced from the original parent plants. The next step in the research is to see whether plant cells can be grown as separate individuals, instead of in the tissue masses as at present.

A by-product of the root researches was an experiment in which he demonstrated that these isolated tomato roots develop pressures that could easily carry a column of sap higher than the Washington Monument. For the paper in which he described this experiment, Dr. White received the $1,000 prize of the American Association for the Advancement of Science.

THE HASSEL COMET

THE most brilliant comet to sweep the skies in several years is now flaming low in the northwestern heavens in the early evening. Easily visible to the eye, it is nearly as bright as the familiar North Star and has a tail greater in length than the apparent diameter of the full moon.

The new comet of the third magnitude (the North Star is of second magnitude) was discovered at the University Observatory, Oslo, Norway, on April 16 by the astronomer Hassel, according to cabled reports from Professor S. Rosseland, director of the Norwegian Observatory, to Harvard Observatory, the American clearing center for astronomical discoveries.

The most recent check on the comet's position comes from the observatory of the University of Copenhagen. Its position on the evening of April 18 was right ascension two hours, seven minutes and 58 seconds and its declination was plus 43 degrees, 15 minutes and 53 seconds, according to reports from Miss J. M. Vinter-Hansen, astronomer at Copenhagen, and her associate, J. P. Möller.

This places the comet in the constellation of Andromeda near the bright star Almak. Andromeda is low in the northwest sky in the very early evening and disappears below the horizon about 7 P.M. local time in latitudes comparable with Washington. Only swift observing between sunset and the disappearance of the comet below the horizon will spot it. However, once found it can be seen easily because of its brilliance.

The Hassel comet, while at present in a rather unfavorable position for night-time observation, is so bright that it should be possible to observe it with large telescopes during the day-time. The right ascension of the star is so nearly the same as that of the sun that it sets and rises at very nearly the same time. It is thus possible to see it at sunset and probably, also, just before sunrise in the southeast.

The comet was nearest to the sun—and hence brightest—on April 10. It is now moving away from the sun and earth and will rapidly become fainter. On April 19 it was of the third magnitude, easily visible to the unaided eye, and can be found in the constellation of Perseus in the northwest. It is moving rapidly southeast and soon will enter the constellation of Auriga.

NEW PUBLICATIONS!

A Resurvey of the Development of Lymphatics and Associated Blood Vessels in Anuran Amphibia by the Method of Injection

HENRY McE. KNOWER
Osborn Zoological Laboratory, Yale University

The American Anatomical Memoir, No. 18

April, 1939

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MATHEMATICS AND MODERN LIVING

PROFESSOR GEORGE D. BIRKHOFF, dean of the Faculty of Arts and Sciences, Harvard University, in an address at Catholic University, stated that nearly one half of the circle of human thought has already become definitely mathematical in character. Already encompassing the fields of the physical and mathematical sciences, the study of mathematics is now influencing the field of economics. He continued: "I would conjecture that this tendency will extend still further into such fields as sociology and law, where mathematical analyses may introduce much clarification and simplification.

Professor Birkhoff's address on "The Role of Mathematics in Education" is one of a series of lectures being given by members of the Pontifical Academy of Sciences in celebration of the Golden Jubilee of the Catholic University of America.

A knowledge of mathematics and the sciences (using the language of mathematics) is essential for advancement and understanding of the modern world, Professor Birkhoff said. He cited a survey of the men in Who's Who to back this point, showing that between 30 and 40 per cent. of these outstanding men have a considerable scientific and mathematical background. He pointed out that mathematics of an advanced stage need not be taken by all college students. What is really essential is the fostering of the student's intellectual enthusiasm and initiative.

Professor Birkhoff predicted that within a few years an appreciation of the beauty, grandeur and basic importance of mathematical thought would become much more widespread.

ITEMS

DINOSAURS, pterodactyls and other weird extinct reptiles crowd two new halls of the American Museum of Natural History, which was shown in preview to a group of invited guests on the evening of April 17 and opened to the general public the following day. The total number of exhibits exceeds 200, and the specimens range from the size of bantam roosters to the great "thunder-lizard" that in life weighed 15 tons. A dramatic grouping shows the skeleton of a great spike-toothed carnivorous tyrannosaur stooping over the remains of a larger but herbivorous dinosaur, as if about to rend and devour its flesh. While some of the exhibits have been in the museum's collections for many years, so many new exhibits have been added that a complete rearrangement was necessary, in addition to the construction of a new and magnificent Jurassic Hall.

SOVIET Russia will take a long step toward solution of its urgent transportation problem during the third five-year plan by cutting an eight-and-a-half-foot channel in the shallow reaches of the Volga River to make possible a through waterway between Moscow and the raw materials base of the lower Volga region and the Urals, according to a report from Tass, the Soviet news agency. Now little more than a yard in depth upstream from Rybinsk, the channel will open a 2,000-mile waterway, shortest and cheapest means of transportation through the entire Volga region. Moscow is already linked to the river by a canal.

POINTING the way toward possibly finding eventually another use for their seemingly curious laboratory toy, the molecular film only a millionth of an inch thick, General Electric investigators have found that their inconceivably thin films may have insulation values comparable to the best known dielectric insulating materials in use. Already applied to the production of glareless glass in one instance, thin films of another type are having their insulating properties studied by Dr. H. H. Race with apparatus that makes a dust particle appear like a mountain. Infinitesimal quantities of materials such as barium stearate are being used in the new experiments. The films' areas are only about three thousandths of a square inch—about that of the head of a pin. "The investigation is really one of pure science, but . . . what to-day is only an interesting fact may to-morrow be applied."

SULFURIC acid pollution in the Ohio River and its branches has already been reduced 25 per cent. by the mine-sealing program carried on by the Works Progress Administration, with the cooperation of the U. S. Public Health Service. In the Monongahela River alone, the principal water source for Pittsburgh, Morgantown, W. Va., and other cities, the noxious acid content has been reduced approximately 30 per cent. Many of the streams in this great watershed are now wholly free of acid; the waters have been cleared and can be used for drinking and bathing, fish life has returned and plants have sprung up on the once bare banks. Sulfuric acid forms in mines when air and water come into contact with iron pyrites. The acid water then flows from the mines into the streams. The discharge amounts to 2,802,000 tons of sulfuric acid per year. Treatment consists in blocking all openings of abandoned mines, to prevent the entrance of air and water, and in keeping operating mines as well closed up as practicable. Thus far a grand total of nearly 116,000 mine openings have been sealed, at a cost approaching six and one half million dollars.

LIGNIN, waste wood product in paper-pulp making, has had another addition made to its growing list of possible uses by chemists of the U. S. Department of Agriculture, at the Agricultural By-Products Laboratory at Ames, Iowa. They have found it to be much more efficient than chemicals now in use for the removal of iron from water. Iron is a problem in most city and industrial water supplies. Lignin is a problem in the wood-products industries. Put the two together and they solve each other. Lignin is very cheap because of its great abundance, and the little use hitherto found for it. Yet cheap as it is, it can be used with still further economy in the iron-removal process, because it can be used over and over again, as often as ten times, with no appreciable lessening of efficiency. A compound now in use was tried out in parallel tests and found not only to remove less iron at any one time, but also to lose its efficiency after only six runs.

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SCIENCE NEWS

Science Service, Washington, D. C.

SOME PAPERS READ AT THE WASHINGTON MEETING OF THE AMERICAN PHYSICAL SOCIETY

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CREATION of the highest continuous magnetic field in the world was reported by Professor George R. Harrison and Dr. Francis Bitter, of Massachusetts Institute of Technology. Using a new type of electromagnet, the scientists split spectral lines in a field of 100,000 gauss. This is a magnetic field strength 500,000 times as great as the magnetism of the earth that turns compasses. Professor Peter Kapitza, of Russia, has previously produced brief magnetic fields of 300,000 gauss but they lasted only one hundredth of a second. The electromagnet can produce its 100,000 gauss field and hold it steady within one tenth of one per cent. for hours at a time. At its peak of operation, the electromagnet uses 1,800 kilowatts of electricity, an amount of power sufficient to operate 36 radio stations of the size of the largest commercial radio stations in the United States, of 50 kilowatts rating each. The intense magnetic field was used to produce the so-called Zeeman effect, the splitting of spectral lines in the presence of a strong magnetic field.

NEW discoveries showing that lightning strokes travel at 1,000,000,000 centimeters a second (at a rate of more than 22,000,000 miles an hour) were described by J. M. Meek, of the University of California. The initial act of a lightning discharge is to create a "pilot" streamer of comparatively low velocity which, nevertheless, speeds along at 20,000,000 centimeters a second. The electrical current in this pilot streamer is about one tenth of an ampere. The diameter of the streamer is about one eighth of an inch. It is estimated that in a cubic centimeter of its "tip" there are 100,000,000,000 ions present. The later discharge, known as the step leader, has the much higher velocity of 1,000,000,000 centimeters a second.

A NEW step forward in the study of how ultraviolet rays kill bacteria and other micro-organisms was described by Drs. F. S. Brackett and Alexander Hollaender, of the National Institute of Health. That intense ultra-violet rays destroy organisms has long been known and has recently been applied in hospital operating rooms to decrease operative infection. Similarly it has been used to sterilize public drinking glasses and to decrease bacterial growth in the quick curing of meat. Exact knowledge of just which wave-lengths in the ultra-violet spectrum are the most efficient in killing power has been scanty, however. The lethal efficiency of ultra-violet light on bacteria over the wave-length range of from 2,180 to 2,950 Ångstrom units was studied. Not all waves in this region are equally effective. The new curves plotting killing efficiency against wave-length will be extremely useful to those studying in this important field.

FOR the first time, it was reported, the same free surface of a metal has been studied for its optical and photoelectric properties. Dr. Donald M. Packer described work at the University of Rochester on the optical constants of freshly made potassium films formed in a vacuum on pieces of glass chilled to the temperature of liquid air, 192 degrees below zero Centigrade. The virgin surfaces changed so rapidly that measurements could not be repeated on any one surface.

WHAT may be the most energetic atomic bombardment yet employed by science was described by Drs. L. D. P. King, W. J. Henderson and J. R. Risser, of Purdue University. Using helium atoms, which had lost two electrons and were thus doubly ionized, atomic particles were obtained in the big Purdue cyclotron having energies of 16,000,000 electron volts. With this terrific beam of about 100,000,000,000 atomic "bullets" a second, they bombarded many substances. Using pure graphite (carbon) a previously unnoted artificial radioactivity having a half life of 2.1 minutes was produced. It can not be produced for bombarding energies less than eight or nine million electron volts.

THE curious greater absorption of the atomic mesotron particles (found in cosmic rays) in passage through air, than through an equivalent amount of dense lead, has been explained by saying that these new-found, welter-weight particles spontaneously disintegrate as they travel along. Thus in passing through large distances of air more of them are lost by self-disintegration than would be through the much shorter distance of lead having an equal absorbing power. This hypothesis may not be all the story, according to Dr. and Mrs. C. G. Montgomery and Drs. W. E. Ramsey and D. B. Cowie, of the Bartol Foundation, who described new experiments in which trays of Geiger counters, placed over a layer of two centimeters of lead, detected mesotrons entering the lead. Below the lead was another layer of counters detecting electrons resulting from the disintegrating mesotrons. The difference in the counts measured the mesotrons stopped by the lead. It was found that some yet unrecognized type of absorption is at work removing slow cosmic ray mesotrons in the lead in addition to any disintegration which may be present.

THE neutrino—a hypothetical, elusive atomic particle, has been long-sought but never found. Investigators of the University of Michigan reported that new experiments show the effects of this tiny ghostly particle. As a "ghost" the neutrino is no malevolent entity. Rather it serves law-abiding physicists in their studies of nature and helps them to avoid breaking the laws of the conservation of momentum in interpreting their atom-smashing experiments. Drs. H. R. Crane and J. Halpern, of the University of Michigan, described one such experiment that would controvert the momentum laws unless the neutrino is present.

THE most sensitive current-detecting device ever developed by science was described. Dr. James S. Allen, of the

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University of Minnesota, told of a vacuum tube which will measure the minute amount of electricity carried by a single electron passing down a wire every five minutes. This corresponds to a current of 0.000,000,000,000,000,000,001 amperes. The best previous current detector measures, in comparison, 20 electrons a second. Thus the field of sensitivity has been pushed back 6,000 times by the new device. The two-inch diameter vacuum tube—a modern Aladdin's lamp——is the product of research in television.

A NEW "camera" using 66 different "plates," all at once, is being used to study the tracks of atoms scattered by targets in the 7,000,000 electron-volt cyclotron of the University of Rochester, according to a report made by Professor T. Russell Wilkins and Dr. Gustav Kuerti. By means of this camera, Professor Wilkins said, he hopes to gather reliable data which will reveal the nature of the tremendous energy with which an atom repels the millions of atomic particles shot at it in the atom-smasher during the course of only a few minutes. The device consists of two circular plates in whose center is placed the target to be bombarded in the cyclotron. As atomic projectiles enter the ring around the target and are scattered they travel through small pin-holes into one or more of 66 slots. Each slot contains a photographic plate with a specially prepared emulsion. In the emulsion the particles make tracks, or "footprints."

ALCOHOL is a quicker pain-killer than any drug, even morphine, and six aspirin tablets are no better than one, it has been found in studies on the human body's tolerance to pain. Describing the first exact physical measurements on the threshold of pain in the human body, Drs. J. D. Hardy, H. G. Wolff and H. Goodell, of the Russell Sage Institute of Pathology, Cornell University Medical College, New York, said that the pain produced over a large area of the body is no greater than is the pain produced over a small area. Thus there is no summation of pain as there is with the sense of touch, sight or the body's detection of heat and cold. "This finding," Dr. Hardy stated, "may represent a wise provision of nature which wants the body to be very sensitive to heat but which warns the body as much for the destructive stimulus on a small area as on a large one." By injection of drugs it was found the total effect obtained by aspirin is secured after the first tablet is taken. Six tablets do no better. Rating intolerable pain as 100 per cent., the scientists reported aspirin's relative effectiveness as 35 per cent. At the same time they found that injections of alcohol rated 40 per cent. And they found that the alcohol acted within 15 minutes instead of hours required by other drugs.

PROFESSORS J. A. PIERCE and H. R. Mimno, of Harvard University reported that reflections off the radio "mirrors" high over head in the sky have disclosed the presence of swift-flying clouds of ionized atmosphere which travel with velocities as great as 310 miles an hour. These clouds, although invisible to the eye, can be shown to be thin layers.

PROGRESS in the art of depositing thin films on glass to change the original reflection characteristics was reported by Drs. C. Hawley Cartwright and A. Francis Turner, of the Massachusetts Institute of Technology. While originally ways of producing almost a complete absence of reflection from glass surfaces by the use of films were described, the new findings show ways to produce extra high reflections. They do this by depositing alternate layers of materials having high and low indices of refraction. With such a system they are able to increase the reflecting power by 80 per cent. for any pre-selected wavelength of light. By choosing film thicknesses suitably they have developed a color filter which will reflect 85 per cent. of the green light and transmit 90 per cent. of the red.

SOMEWHERE, somebody and somehow scientists may learn how to release the energy locked up in atoms of uranium but it is becoming increasingly clear that there will probably never be a catastrophic explosion of the uranium in the world as has been suggested in speculative predictions on the release of atomic power by such experiments.

At the meeting of the American Physical Society new reports of researches on the splitting of uranium and the release of its amazing stores of atomic energy show that the bombardment of uranium with a neutron has about three times the chance of merely being captured as it has of splitting the uranium atom and giving off relatively enormous amounts of energy.

Professor Niels Bohr, of Copenhagen, now at the Institute for Advanced Study at Princeton, gave the picture of the known facts about uranium's splitting to his fellow scientists. Only high speed and high energy neutrons can split ordinary uranium of mass 238, he said. The same is true for the splitting of thorium. The slow neutrons of less energy are effective only in splitting the rare isotope of uranium having mass 235.

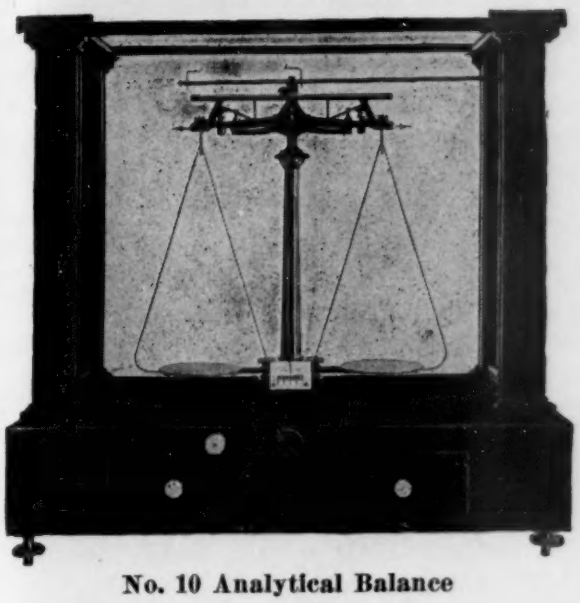
The point is that to release atomic energy for practical purposes it is necessary to have a "chain" reaction in which a split uranium atom will give off a neutron which will split one near-by, and so on.

However, new experiments at Columbia University and elsewhere show that these secondary neutrons from uranium splitting are only weakly energetic. By theory they can split only the rare uranium of mass 235 and there is not enough of this isotope present to keep the chain going. That they can do so, moreover, is mere hypothesis for Professor Bohr's picture has not yet been checked by experiment.

Having dimmed speculation on ordinary uranium's ability to release usable atomic power the scientists must now, however, consider the idea that if sufficient amounts of uranium of mass 235 could be purified it might be possible to create a chain reaction. Efforts are being made to find some way in which this rare isotope can be concentrated in sufficient amounts to try the experiment. So far no method has given promise of success.—ROBERT D. POTTER.

ITEMS

THE American Medical Association each year classifies the deaths of all physicians and, as it has been for many years, heart disease was again the leading cause of these



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fatalities in 1938. Thirty-nine per cent. of all physicians who died last year were victims of heart disease. About 12 per cent. of them died of arteriosclerosis; 10 per cent. of cerebral hemmorhage; 8 per cent. of pneumonia and almost the same proportion of cancer. The average age of death of American physicians was 65.6 years, as compared with 65.4 years in 1937. Accidental death claimed 155 American doctors, automobile accidents accounting for 81 of these. Another 81 doctors committed suicide.

AMERICAN medical graduates make much better showing in American licensing tests than candidates from abroad. Among graduates of approved schools of medicine in the United States only 11.7 per cent. failed state board examinations while 38.3 of those educated abroad failed to pass our examinations. The *Journal* of the American Medical Association says that the poor record of graduates of foreign medical schools can be only partially explained by the fact that they may not have mastered the English language, since many of those educated abroad were born and raised in this country.

MORE sky can be seen with the new McDonald Observatory 82-inch telescope, to be dedicated at Fort Davis, Texas, May 5, than with any other American telescope. This is because McDonald Observatory is farther south than any other observatory in the United States. It can be sighted upon thousands of stars that never come within range of more northern telescopes. The entire sky except for a 30-degree radius circle around the South Pole will be covered by the new telescope giant. The McDonald telescope will record star light a million times too faint for the human eye to perceive. An outstanding gathering of astronomers from this country and abroad will attend the dedication ceremonies.

A DEVICE for automatically dimming automobile headlights when one car approaches another head on has been patented by Russell E. Alley, Austin, Minn. Great simplicity is accredited to the device. Besides its automatic features, no extra equipment on an automobile is needed, the storage battery providing the electric energy necessary to "feed" the lights. An important feature of the safety headlight is a novel device wherein a single triode tube controls a single relay and this, in turn, effects tilting of the headlight beam on the approach of another automobile, with its headlights blazing. Mr. Alley has assigned one third of his patent rights to Francis N. Earl, Austin, Minn., and one third to Bennett J. Porter, Albert Lea, Minn.

AMERICA'S frontiers are being successfully defended against yellow fever invasion, according to a report of the U. S. Public Health Service. The invasion of that deadly disease enemy has threatened since the establishment of air travel between this country and South America where dangerous centers of the disease exist. The danger was two-fold: Patients infected with yellow fever might arrive in this country, *via* speedy air travel, before the sickness was detected; yellow fever-carrying mosquitoes, *Aedes aegypti*, might stow away on the planes. No yellow fever mosquitoes were found on planes arriving at the Pan American airport at Miami from Central and South America and Mexico during 1938. Fewer live mosquitoes of all kinds were found than in the preceding year. In spite of precautions taken by the airways and health authorities, live mosquitoes and other insects, however, are still being transported into this country by aircraft, the Federal Health Service reports. This seems to indicate that defenses against a yellow fever invasion must be kept up.

THE new drug sulfapyridine apparently shortens the course of pneumonia by three or four days when used in treating infants and children. Six Cincinnati physicians report on the effect of the drug on the pneumonias of infancy and childhood after a trial period at the Children's and the Cincinnati General Hospitals, Cincinnati, in the forthcoming issue of the *Journal* of the American Medical Association. Of seventy small pneumonia patients, half were given sulfapyridine and the others were used as controls. It was demonstrated that the fall in temperature and the clinical recovery were significantly earlier in the sulfapyridine group than in the control group. The optimum dosage needs further study, and the series of cases was too small to permit an evaluation of the effects of sulfapyridine in preventing the complications of pneumonia, according to the authors of the article, who are: Drs. Armine T. Wilson, Arthur H. Spreen, Merlin L. Cooper, Frank E. Stevenson, A. Graeme Mitchell and Glenn E. Cullen.

FOR the first time since sound motion pictures came into use more than ten years ago the motion picture industry has a noiseless camera which can be used inside a sound studio without any sound-proofing box, or "blimp" as it is known in the industry. The new silent camera, weighing only 60 pounds, was described at the meeting of the Society of Motion Picture Engineers at Hollywood, Calif., on April 21 by G. Laube of the Twentieth Century-Fox Film Corporation. The monitor view finder truly conforms to the image being photographed on the film so that the cameraman no longer has to make allowances for parallax. The camera turret mounts four lenses which are quickly changed, while the entire camera is sealed from the action of sand, dirt or water.

Two Handley-Page-Harrow bombers, converted to serve as airplane tankers for refueling British transatlantic flying boats in mid-air, will be shipped to Montreal on the *S.S. Beaverburn* within the next few weeks. The British transatlantic air fleet of four Short flying boats has been designed for take-off at a gross weight of 46,000 pounds. Once in the air they will be loaded to a weight of 53,000 pounds. Each of the converted bombers can carry 1,000 gallons of fuel for refueling purposes. Montreal will be the service base terminus of the British airline, which will begin to carry mail early this summer. The British flying boats are not quite as large as the four planes to be used on the American service to be operated shortly by Pan American Airways. The American boats will take off with their full load of fuel.

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SCIENCE NEWS

Science Service, Washington, D. C.

EXPANSION OF THE MILKY WAY

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A GIGANTIC aura of escaping, super-speedy stars has been discovered enveloping our own universe of stars, the Milky Way, through the researches of Dr. Harlow Shapley, director of the Harvard Observatory, and his colleagues. This increases the dimensions of our nebula or galaxy to the vast extent of an approximate sphere nearly half a quintillion miles in diameter. That is a chunk of space so large that it takes light some 80,000 years to cross it. Dr. Shapley announced the discovery in the first scientific session at the dedication of the McDonald Observatory on May 5.

The great aggregation of stars in which our sun is located is seen as the Milky Way in the night sky. Great telescopes, such as the new one going into service on the Texas mountain top at Fort Davis, show thousands upon thousands more stars than the eye can see. Most of the stars are located in a thin elongated disc 6,000 light years thick and some ten times as long. Ninety-nine out of a hundred stars of our galaxy are in this most densely star-populated part of the galaxy.

What is newly discovered is that stars unquestionably belonging to the Milky Way are found far beyond its old limits. These are faint and of high velocity, speeding some 120 miles per second. Dr. Shapley believes that they are the lighter stars that have in effect been thrown out from the main body by gravitational effects. Mathematical physical theory agrees with the actual astronomical finding that this envelope or shell forming this greater galaxy should be a sphere in shape and not a disc like the main mass of the Milky Way. When inquiring telescopes and photographic plates are pointed at other nebulae or galaxies, such as that in Andromeda, similar star-halo envelopes or shells are found. In some cases the shells of galaxies overlap with those of other, near-by galaxies. The limits of the shell are very indefinite, just as it is difficult to say just where the earth's atmosphere definitely ends.

The two most recently discovered near neighbors in space to our Milky Way, unusual star aggregations in the constellations of Sculptor and Fornax, have had their distances from us determined by use of famous Cepheid variable stars, whose waxing and waning of light measure the universe for astronomers. They are about 300,000 light years away. Dr. Shapley explained that they are part of our super-galaxy, which roughly includes the volume of space within a million light years of us.

THE RELEASE OF ATOMIC POWER

(Copyright, 1939, by Science Service)

RELEASE of atomic power is "not at all impossible" and "closer than ever before," Dr. Arthur H. Compton, of the University of Chicago, told the Southern Division of the American Association for the Advancement of Science meeting at Alpine, Texas, in a preliminary to the McDonald Observatory dedication on May 5.

The provision of power for our civilization is one of the major problems that scientists must solve. From the standpoint of chemical and mechanical power, those living to-day are in a preferred position. We are using the petroleum and coal stored up in past ages. While there are possibilities of obtaining power from the wind, agricultural products and other current sources not now largely utilized, Dr. Compton explained that society needs ever more and more power.

The most promising possibility for the future, in Dr. Compton's opinion, is the release of atomic power, brought definitely within the realm of possibility by the recent splitting of the uranium atom. There is evidence that heat and light from stars are produced by changes within the hearts of the atoms in much the same way that artificial radioactivity is created by atomic bombardment. Dr. Compton therefore believes that the astronomer, using new tools like the giant reflector of the McDonald telescope, can help physicists to try to make efficient on earth the methods used in the sun and stars for transmitting matter into energy.

A NEW MATHEMATICAL CONCEPT OF THE UNIVERSE

(Copyright, 1939, by Science Service)

A NEW kind of universe built out of mathematical logic instead of physical observation, yet capable of encompassing and explaining other suggested universe pictures painted by Newton, Einstein and other cosmologists, is offered to science by the British mathematical astronomer, Dr. E. A. Milne, of the University of Oxford, speaking at the dedication program of the McDonald Observatory.

A sort of universe to end, or at least reconcile, all universes, the Milne cosmology has the appeal of being more philosophically and religiously satisfying. It does not call upon any irrational factors or mystical ideas to explain it. Not only is the immense far-flung expanse of galaxies explained, but the Milne universe can be applied to the hearts of atoms, gravitation and electricity. Although its need arises out of the American exploration of space with giant telescopes, resulting in the discovery of millions upon millions of giant galaxies of stars, Dr. Milne's universe-building discards as a basis the physical observations of the world about us. Instead of starting with what the telescopes show to be in the visible universe, Dr. Milne builds physics from the bottom up, renouncing outside facts, and starting only with the fundamental phenomenon of the passage of time.

By time-tried mathematical procedures, Dr. Milne derives from our individual awareness of the passage of time a system of agreeing time-keeping in different places in the universe. From these time relations come a kind of kinematics and dynamics that are used to give a logical meaning to what is called uniform time. This allows explanations of gravitation and electromagnetism as well as the observed facts about the physical universe.

In a sense, Dr. Milne has attempted to do for physics and astronomy what the Greeks did when they took the

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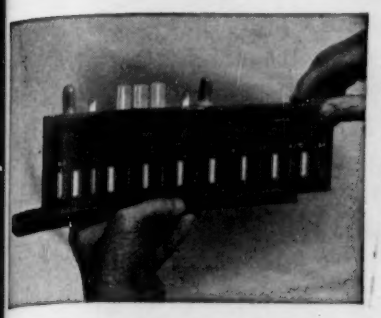

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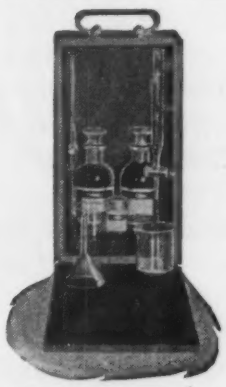

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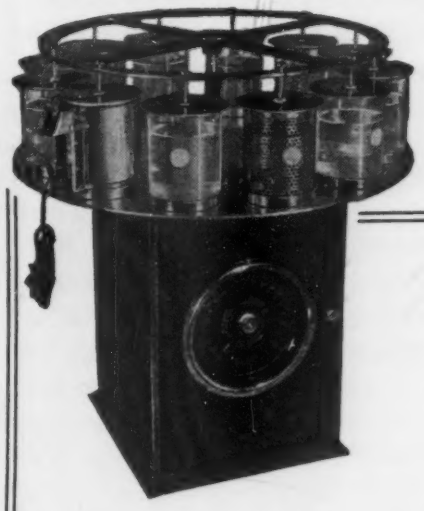

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isolated facts of Egyptian mathematics and combined them into a logical system. The bringing of the atomic world into the same set of rules that governs the rest of the universe is one of the unsolved problems of science. Einstein and others have also been attempting to bring gravitation and electrodynamics into one set of theories. If the Milne picture of cosmology succeeds in accomplishing these objectives, it will be a major achievement.

One consequence of Dr. Milne's work is that the two conflicting conceptions of space and time, the Newtonian static universe and the expanding universe of Einstein's special relativity, can be reconciled and in fact shown to be variations of the real universe. The universe based on Newtonian dynamics, which Dr. Milne calls "Tau time" because he uses that Greek letter to designate it in his equations, is stationary, homogeneous, infinite in extent and hyperbolic in space type. The expanding universe of special relativity in what is called T time has the nebulae or star systems rushing out with tremendous speeds, its matter is not evenly distributed, it has a finite limit to its maximum expansion. It is described as a "flat private space." Yet analysis by Dr. Milne shows that T time becomes Tau time when the universe is viewed from any particular location.

One consequence of the Milne formulations of space and time is that if a material solid rod of some sort could be made to join two great stellar galaxies rushing away from each other at tremendous speeds, it would not break because it would expand at the same rate as the expanding universe of which it would be a part.—WATSON DAVIS.

THE TREATMENT OF PNEUMONIA

(Copyright, 1939, by Science Service)

DISCOVERY of a better drug than sulfapyridine, the new remedy that is revolutionizing the treatment of pneumonia, was predicted by Professor E. K. Marshall, Jr., of the Johns Hopkins University, at the meeting in Toronto of the Federation of American Societies for Experimental Biology. Sulfapyridine is excellent so far as curing pneumonia is concerned, but "it has every disadvantage a drug can have," according to Professor Marshall. It makes many patients miserably ill, as if they had seasickness. More serious is the fact that in some patients it is changed chemically to a substance that forms stones in the kidneys. When sulfapyridine is given by mouth it is absorbed irregularly, making it very difficult to know how much to give to each pneumonia patient. It does not dissolve without special chemical treatment, which makes it difficult to give it to patients by injecting the drug into their veins. For these reasons Professor Marshall believes pharmacologists must and will find some better compound to use in pneumonia.

A discovery that may help doctors to tell at the beginning whether a pneumonia patient will live or die, whether he should get sulfanilamide or serum treatment, and how much serum to give was announced by Dr. Arthur W. Frisch, of Wayne University, Detroit. Dr. Frisch believes that all these facts can be determined definitely by looking under the microscope at a drop of the rusty, bloody sputum a pneumonia patient coughs up. If he can count more than one hundred free pneumonia germs in this drop of sputum, the patient's chances are very bad. If the number is less than ten, the patient is not seriously ill. Dr. Frisch's work is the first attempt to determine the outcome of pneumonia from examination of the rusty sputum. Heretofore doctors have been guided by the number of white blood cells, the number of lobes of the lungs affected and the presence or absence of pneumonia germs in the blood. For the first time, also, Dr. Frisch has learned exactly what sulfanilamide does to pneumonia germs in human patients. The effect of the drug, he finds, is to decelerate the growth of the germs for from two to four days. After that time, the germs become resistant to the action of the drug and continue to grow. Pneumonia serum has exactly the opposite effect. It does nothing to the germs but increases the body's defensive forces. For these reasons Dr. Frisch believes a combination of serum and sulfanilamide is the best method of treating pneumonia. How much serum to give can be determined, he believes, both by the number of free pneumonia germs in the patient's bloody, rusty sputum and by whether or not the germs are clumped together. The clumping indicates that the patient is developing immunity to the germs, he believes, and consequently that less serum is needed. Because of the high cost of serum treatment, estimated at from at least $75 to $100 per case, it would be an advantage to know when serum treatment could safely be stopped.—JANE STAFFORD.

THE FIGHT AGAINST GRASSHOPPERS

(Copyright, 1939, by Science Service)

GRASSHOPPERS are beginning to emerge from winter quarters in the main crop and range areas east of the Rockies; the current battles raging in California are only preliminary actions with the advance guard.

The 'hopper hordes will be very numerous this year, as is indicated from egg surveys conducted by field workers of the Bureau of Entomology and Plant Quarantine. Myriads of eggs were left in the soil last fall by the last generation of female insects, and the winter survival rate was high.

Defenses are already being prepared. A continuing appropriation, authorized by the Congress several years ago, enables the embattled entomologists to prepare and distribute their ammunition well in advance of the anticipated campaign, and the agricultural appropriation bill now up for action carries provision for additional funds. In addition, there are small quantities of poison bait left over from last year, sufficient to rush into immediate action if required.

Poison bait is materially cheaper now than it used to be. It has been found that the bran, formerly used "straight," can be mixed with a considerable proportion of sawdust before the arsenic is added, and that the grasshoppers do not seem to know the difference.

Poison bait will be distributed along the grasshopper front in the great crop areas, as usual. The crucial stage of the campaign, however, will not be reached until early June. If the rangelands of the Plains Area dry out then the grasshoppers will migrate, and it will be necessary to send poison-warfare forces into the range areas. Whether this action will become necessary can not be

rmined for several weeks. Meanwhile the California nt has received reinforcements from the CCC camps. he Forest Service has detailed 100 young men from three mps to assist in the fight against the swarming insects. Other insect pests attacking grain do not look particurly serious at the present time. Mormon crickets are awling out of the coulées in the Great Basin country d elsewhere in the West, but on the basis of present indiations government entomologists do not expect this to be bad a Mormon cricket year as 1938 was. Chinchbug d Hessian fly infestations seem to be low.

THE FOREST FIRE HAZARD

(Copyright, 1939, by Science Service)

THIS spring's long wet spell in the eastern half of the ited States, which has driven farmers to despair beuse it made their fields too wet to plow, has been hailed a blessing by foresters because it made the woods too t to burn.

Especially in New England has this been the case. ate snows, followed by persistent rains, have kept the t tinderbox of down trees left by last fall's hurricane ll blanketed against the fire that the whole region ghtly dreads. Meanwhile thousands of axes and saws e working against time, to salvage the timber for use d remove as much as possible of the fire hazard.

Congress provided a $5,000,000 appropriation for the lvaging of the wind-felled trees. Already about $3,-00,000 worth of logs and sawed lumber have been bought d are in storage, the logs in ponds and the lumber in arded piles. The logs amount to some 255,000,000 board et, the sawed lumber to 30,000,000 board feet. There e 200 sawmills under contract for the work, of which 5 are now operating. In the woods 1,200 men, mostly rmer CCC enrollees, are doing the front-line work. They nstitute 25 fifty-man camps, which are kept on a mobile nis.

It is only during the past few days that the woods have gun to show signs of drying out. The foresters and mber workers know that their rainy luck can not last rever and they are taking advantage of every possible rking day. Even after the fire season starts, they will ep up the battle, until either they or the flames win out.

Elsewhere in the country, the forest fire situation is ginning to shape itself——in some regions quite critilly. The Pacific Coast forests are already acutely enaced by fire, in a region where the "normal" fire ason does not open until July. Long and severe drought the coast, especially toward the north, is responsible.

High danger of forest fire also exists in the Southwest, Arizona, though New Mexico forests are not in a ngerous state at present. Other danger spots reported the U. S. Forest Service are Alabama and the Southn Appalachians. Foresters in other parts of the Southst, the East and the North Central areas report only low to moderate" fire hazards.—FRANK THONE.

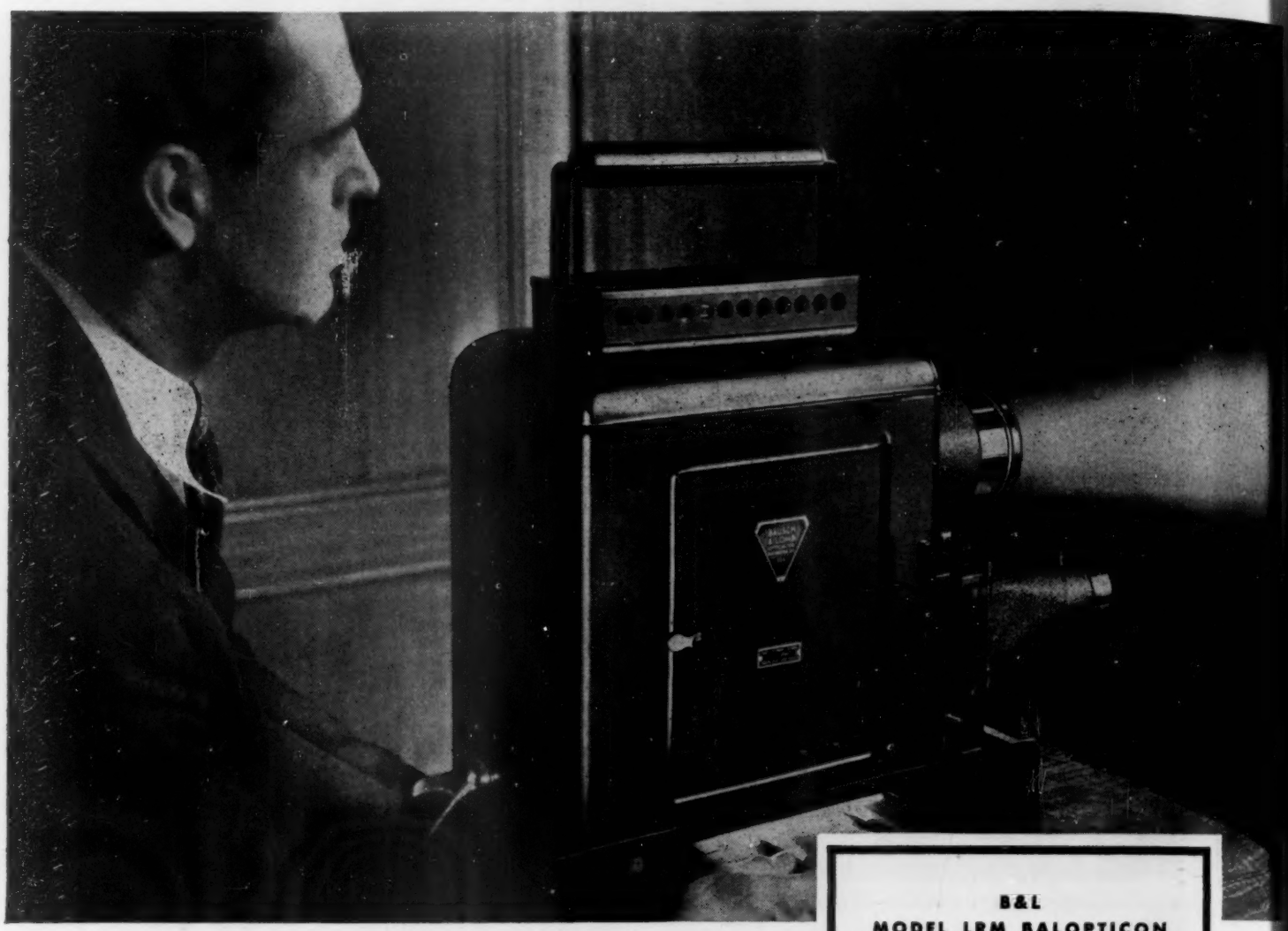
ITEMS

A GIANT iron meteorite, among the half-dozen or so rgest to be found in the United States, is being brought t of the Modoc National Forest in northeastern California, where it was found last fall by a hunting party. Because it was discovered on U. S. Government-owned land it has become the property of the Smithsonian Institution in Washington, D. C. It is to be taken to San Francisco for display at the World's Fair, and next autumn will be shipped to the U. S. National Museum for permanent exhibition. The great wedge-shaped sky-iron, which is four feet long and from one to three feet wide, with an estimated weight between one and three tons, was discovered by C. A. Schmidt, of Oakland, while on a hunting trip last autumn. Mr. Schmidt informed U. S. Forest Service authorities, who have kept the information confidential until now, so that preliminary scientific investigations could be made.

MARKING the first large-scale installation of blind landing equipment on commercial planes, apparatus for use with the Bendix curved glide path system is being installed for training and test purposes aboard ten transcontinental airliners of United Air Lines. The apparatus will be used during the coming summer months to teach pilots how to fly their way into airports without looking out the cockpit window. For training purposes only, blind landings will be made only under good weather conditions. The airline is not planning any immediate use under bad weather conditions, nor will it change its minimum visibility-and-ceiling rules. Should a superior system make its appearance in the future, it will be able to change over readily and its pilots will have the benefit of training in instrument landings.

SHELLS from two thousand eggs have been used to fill the glass in place of sand in the world's largest swinging hour glass, a part of a half-ton pendulum disc swinging at the end of a 24-foot shaft in a special timepiece on view at the World's Fair to symbolize leisure made possible by electrical equipment, designed by engineers of the Westinghouse Electric and Manufacturing Company. Colored and crushed, they weigh but 28 pounds. The equivalent volume of sand would have broken the glass. In resorting to the eggshells, the engineers resorted to an ancient practice of the Phoenicians, who also used eggshells.

COMMON gray house mice are accused of new wickedness —carrying the virus of a central nervous system disease and transmitting it to human residents in the house. Corralling mouse suspects from two Washington homes in which this disease, choriomeningitis, has appeared, Dr. Charles Armstrong, senior surgeon of the U. S. Public Health Service, reports that the active virus of the disease was isolated in three out of five mice. "The failure to find the infection in twenty-one mice trapped in eight homes and buildings wherein human cases had not occurred indicated that the association between the human cases and the infected mice is more than a coincidence." The disease, characterized by acute onset, headache, nausea or vomiting, stiff neck and moderate rising fever, is usually followed by recovery in ten days to two weeks, without any paralysis or nerve complications remaining as an after-effect.



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Allen—SEX AND INTERNAL SECRETIONS

Edited by EDGAR ALLEN (Yale), CHARLES H. DANFORTH (Stanford) and EDWARD A. DOISY (St. Louis U.), 27 Contributors. *Second edition (1939)*, **6 x 9, xxxvi + 1334 pp., 454 illus., 2 color plates, numerous tables, $12.00.**

The first edition of this important work in 1932 speedily established itself as Science News Letter said, "Absolutely necessary for both experimenter and clinician" and as the Journal of the A. M. A. said, "Indispensable for those interested in the scientific aspects of sex and internal secretions. Physicians interested in any phase of endocrinology should read it."

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The contributors include: Edgar Allen, W. M. Allen, R. W. Bates, C. B. Bridges, C. H. Danforth, E. A. Doisy, L. V. Domm, E. T. Engle, H. L. Fevold, W. U. Gardner, R. G. Gustavson, C. G. Hartman, F. L. Hisaw, F. C. Koch, F. R. Lillie, K. E. Mason, C. R. Moore, W. O. Nelson, W. H. Newton, J. P. Pratt, Oscar Riddle, A. E. Severinghaus, P. E. Smith, C. P. Stone, C. W. Turner, B. H. Willier, Emil Witschi.

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SCIENCE NEWS

Science Service, Washington, D. C.

THE GEOLOGY OF THE BOTTOM OF THE OCEAN

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DR. MAURICE EWING, of Lehigh University, at the Washington meeting of the American Geophysical Union, described his experiments in the deep waters around Bermuda, by the seismographic method. Charges of explosive were set off to send small earthquake waves down to underlying rocks. These waves are reflected by the rocks, and the reflected waves picked up and recorded by portable seismographs put down at suitable distances. Time of travel and shape of waves can be interpreted in terms of the geological nature of the underlying strata.

This is relatively easy on dry land, but at depths of hundreds or thousands of feet in the ocean it became more difficult. The first method was to attach charges of TNT and recording instruments in a long string to a cable, which was then trailed on the bottom by a towing ship. This was a possibility in shallow water, but began to be prohibitively cumbersome when it came to real depths. The charges and instruments could be sunk unattached, of course; but how could the instruments be got back again? Dr. Ewing arranged to sink his charges and his instruments with heavy weights, but with floats attached to bring the instruments back to the surface when the work was finished. The weights of course had to be heavy enough to carry both the instrument and the float to the bottom. For floats he used tanks of gasoline. Hollow, air-filled floats would come up faster, of course; but in very deep water these would be crushed by the tremendous pressure and fail to come up at all. Gasoline would keep the tanks from collapsing, but was enough lighter than water to come back to the top all right.

The TNT charges were not cased in metal bombs, but only in ordinary five-cent rubber balloons. These were adequate to keep explosive and detonating fuse dry. At the end of a length of electric cable was a clockwork timing device with an electric trigger, to set off the charge at exactly the right second. When the charge exploded, that released the timing device attached to the gasoline-filled float, which then carried it to the surface, where a little flag would guide the experimenters to pick it up. A second release, consisting of a block of rock salt, was also attached. In case the charge missed fire, the dissolving of the salt would set free the float and its valuable timing device. Similar floats and the double arrangement of a clockwork and a rock-salt release were attached to the seismographs, which were dropped overboard at suitable distances from the TNT charges. Experimental runs have been made at depths as great as 2,400 fathoms, or 14,400 feet.

Since the studies were often conducted far at sea, out of sight of any land on which bearings might be taken, the problem had to be met of the research boat drifting away from the station and thereby losing all the apparatus as it floated back to the surface; for several hours are necessary for a run. Dr. Ewing finally solved this problem very simply. He dropped to the bottom, along with his TNT and seismographs, a number of gasoline-filled floats bearing only the little red flags, with timing devices set to release them at half-hour intervals. So whenever one of these popped to the surface, the boat could steam back from the point to which it had drifted, pick it up, and wait for the next one. It would never drift so far in the half-hour that it was in any danger of losing sight of the area beneath which the experiments were proceeding on the bottom.—FRANK THONE.

HUMAN SPEECH

(*Copyright, 1939, by Science Service*)

AT the New York meeting of the Acoustical Society of America, investigators from the Bell Laboratory showed that a buzz and a hiss combine to give every inflection in the whole gamut of human speech. The buzz-hiss sounds mix and mingle in the throat and mouth and turn into intelligible speech.

Homer Dudley demonstrated a new device—yet unnamed—which takes a spoken sentence apart and then puts it together in any fashion desired. A young man's husky tones turn to those of a quavering old man, or to the pleadings of a lovelorn girl, at the twist of a dial. Basically the new speech analysis instrument is like the Voder—now being shown at the World's Fair—but it is controlled by the speaker's voice rather than by keys.

Mr. Dudley pointed out that the raw materials of speech are two streams of sound. By proper variations of these two streams, intelligible speech is created. The first sound, called the "buzz," has three properties. It has a pitch determined by the fundamental frequency of vibration; an intensity determined by the total sound power issuing from the speaker's mouth; and it has a quality determined by the relative amounts of sound power carried in various frequency bands. The second sound, the hiss, has no pitch whatever and is only a noise.

With his new device Mr. Dudley showed the buzz to have a rich full tone something like a muted automobile horn. By electrical filters ten different ranges of overtones covering the gamut of the human voice could be picked out of the buzz tone. The same filters then broke down the hiss sound into ten corresponding ranges. Thus the machine splits the human voice into 20 parts and then uses the results to control the proper amount of each issuing from a loudspeaker. Only a slight shift is needed to change one vowel sound into another and to turn a word like rat into rot or rut. Using the buzz sound alone, with constant pitch, Mr. Dudley showed that a test sentence came out as a chanting monotone. By releasing the pitch, the device followed the speaker's voice with more naturalness. Normal speech was converted into a whisper when the buzz was changed to the hiss sound. While this hiss is relatively faint, it is essential in human speech in discriminating between such words as "church" and "shirt."

Expression in speech is due to the constant swinging

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By I. E. Melhus and G. C. Kent. To be ready May 23rd. $4.50 (probable)

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up and down of the pitch as one talks, Mr. Dudley showed. When the swings in pitch are cut in half the voice seems flat and dragging; when the swings are twice normal the voice is more brilliant; when the swings are four times normal the voice sounds febrile, unnatural.

SUPER-HEAVY STARS

(Copyright, 1939, by Science Service)

Two remarkable stars made of strange stuff a hundred thousand times heavier than water are the first major discoveries of the new McDonald Observatory 82-inch telescope. Even before this new giant instrument was formally handed over by its makers, Warner and Swasey Company, to the Universities of Texas and Chicago for their joint use, Professor G. P. Kuiper was gathering with the great mirror upon extremely sensitive photographic film light from stars suspected of being relatively close to earth.

He was searching for heavy-weight "suns" that tax the human imagination, stars so dense that a handful of their substance weighs hundreds of tons, stars made of degenerate gaseous matter or atoms stripped to their hearts. Two such mysterious "white dwarfs" new to astronomy were found. One of these is perhaps the most remarkable star ever discovered. It is the faintest such star ever found and it is so close to having no stellar atmosphere that there are absolutely no lines in its spectrum. This star, No. W489, is relatively cool and only such powerful telescope and fast photographic film as used would have detected it.

In six intensive weeks of observing with the 82-inch telescope, Professor Kuiper obtained 600 spectral photographs of 300 stars of large proper motions which showed them to be near us in the Milky Way. Including the two new ones, only 18 white dwarfs are known to science. Professor Kuiper discovered half of these and he has reobserved all of them with the McDonald telescope since March 15.

Most famous of heavy-weight stars is the companion of Sirius, but the heaviest, discovered some years ago at Lick Observatory, is believed to have a density ten million times that of earthly water. This is less than half as dense as the absolute limit for solidness theoretically possible. When the atoms are knocked to pieces completely, without electrons and with only bare nuclei, this degenerate matter, still a gas, strange as it may seem, would be a hundred thousand times a hundred thousand times a hundred thousand times (ten to the fifteenth power) the density of water.

Besides his strange white dwarfs, Professor Kuiper has discovered another family of faint or under-luminous stars. These are about a third of the size of our sun, instead of being about the earth's size, like the true white dwarfs. The subdwarfs are made of ordinary star gas instead of the degenerate superheavy matter.—WATSON DAVIS.

OLD VIOLINS

OLD violins of the masters—the Stradivarius and Guarnerius instruments—have been found to "speak" more easily than do modern instruments, it was reported to the closing meeting of the Acoustical Society of America in New York by Dr. Frederick A. Saunders, of Harvard University.

Working with the noted violinist, Jascha Heifetz, Dr. Saunders has been making exact physical studies of new and old violins seeking to find the reasons—if any—why people will pay $20,000 and more for a single instrument.

Studies at Purdue University, reported Dr. Saunders, show that a good and old violin will vibrate when held in the outstretched hand, if one speaks to it from an appreciable distance. An excellent old instrument picks up enough energy from the sound waves to vibrate.

"This means," said Dr. Saunders, "that the player, when doing a very rapid passage, may just succeed in making an old violin speak properly through the whole of it, while the slight balkiness of a new violin might prevent him from getting through it successfully. No wonder such violins command high prices."

A very keen listener may be able to detect that an old violin speaks more quickly at the turn of a bow than does a new one. Seeking a physical reason why this might be so, Dr. Saunders is now making tests to check the hypothesis that old violins are lighter than new ones. "There is some evidence indicating that they really are," he added. "Some of the constituents of the wood may have evaporated with time. Another cause of ease of response might be that from years of vibration (in use) some of the cell walls in the top plate of the violin may have been broken so that the wood has become more flexible than it was when new. There may be changes in the glue also. When the real changes are determined it ought not to be hard to age wood artificially, so as to get the best effects in a new instrument."

DEATHS FROM TYPHOID IN AMERICAN CITIES

NEW low records for deaths from typhoid fever in the large cities of the United States are reported by the American Medical Association for the year 1938.

The *Journal* of the American Medical Association publishes this week its honor roll of cities with no typhoid deaths.

First place on the list goes to Bridgeport, Conn., with no fatality from typhoid fever in five years. Fort Wayne, Ind., is runner-up, with no typhoid deaths for four years. South Bend, Ind., and Utica, N. Y., have had none in three years. Canton, Ohio; Fall River and Lynn, Mass.; Milwaukee, Wis.; New Bedford, Conn.; Reading, Pa.; Seattle and Tacoma, Wash., and Wichita, Kan., have had no deaths from the disease in two years.

Other honor roll cities with no typhoid deaths in 1938 are: Buffalo, N. Y.; Cambridge and Lowell, Mass.; Elizabeth, N. J.; Erie and Scranton, Pa.; Grand Rapids, Mich.; Kansas City, Kan.; Minneapolis, Minn.; Omaha, Neb.; Peoria, Ill.; Portland, Ore.; Providence, R. I.; Salt Lake City, Utah; San Diego, Calif., and Youngstown, Ohio.

Seven other cities are placed in first rank rather than on the honor roll because they have been charged with deaths among non-residents. These are: Toledo, Ohio; Hartford, Conn.; Syracuse, N. Y.; Worcester, Mass.; Springfield, Mass.; Evansville, Ind., and Camden, N. J.

No outbreak of epidemic proportions was recorded during 1938. Routine vaccination of the population is not practiced except under flood conditions. However, in

progressive communities vaccinations are urged for contacts to cases and for persons who travel widely in insanitary countries.

In this annual survey, the Americal Medical Association notes a trend in some places, particularly in the southern states, to encourage the inoculation of food handlers.

SOME PAPERS READ AT THE MEETING OF THE AMERICAN SOCIETY FOR THE STUDY OF ALLERGY

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A NEW method of treating asthma by reducing the amount of salt in the diet was announced by Drs. A. V. Stoesser and M. M. Cook, of Minneapolis, at the meeting in St. Louis of the American Society for the Study of Allergy. Patients whose asthma was not relieved by the best allergic management stopped wheezing when the amount of salt in their diet was reduced to an extremely small amount. When salt was added to the diet, the asthma promptly reappeared and continued to grow worse even after the added salt was stopped. Six patients with severe asthma which was not relieved by the low salt diet alone improved markedly when in addition to the reduction of salt they were given a pituitary gland extract which causes storage of water in the body.

LACK of the scurvy-preventing vitamin C from citrus and other fruits and fresh vegetables may be one cause of food allergy, according to a report by Drs. J. Bronfenbrenner, D. M. Hetler, Frances Love and Jack M. Burnett, of St. Louis. People with food allergy are the "one man's meat is another man's poison" folks. Eating tiny amounts of certain foods, most often eggs, milk or wheat, gives these patients severe attacks of asthma, hives, migraine headaches or other allergic ailments. Treatment with ascorbic acid, as vitamin C is now called, may enable these people to eat the foods to which they are sensitive. Guinea pigs furnish the evidence for this theory. Pigs made sensitive to egg white could eat this food when they were given the vitamin. When the vitamin was removed from their diet, practically a one hundred per cent. of the animals developed allergic symptoms when fed egg white. If enough vitamin was given to these animals over a period of weeks, they could eat the egg white, still sensitive to the substance.

JANE STAFFORD

ITEMS

REPORTS from the field to the U. S. Weather Bureau indicate that a week of warm weather in the eastern half of the country has done much to cancel out the effects of the long, chilly, wet spell in April. Winter wheat is looking up, and corn planting is getting well under way at last. By the same token, however, the lack of rain is again beginning to cause serious concern in the West. From the grain-fields and rangelands of Montana on the north to the cotton-fields of Texas on the south the threat of a new drought is causing much anxious scanning of the skies. Water for stock is low, and sheep are already being moved to summer range in the Northwest and in portions of the Rocky Mountain region.

DURING the first ten days of this month there have been five major earthquakes that registered themselves on the seismological instruments. The fifth one, relayed to the U. S. Coast and Geodetic Survey through Science Service, happened at 2:44 A.M., E.S.T., on May 10, about 100 miles southwest of Atka Island in the Aleutians, off the coast of Alaska. Epicenter location was given as latitude 51 degrees north, longitude 176 degrees east. The four preceding earthquakes this month were: May 1, Japanese coast; May 2, near coast of Lower California, in Gulf of California; May 6, under Pacific, southwest of Panama City; May 7, near Azores islands, on Atlantic Ridge. Stations reporting the latest earthquake were: Fordham University, Georgetown University, St. Louis University and the Dominion Meteorological Observatory, Victoria, B. C.

THAT young people are more easily trained as good drivers and know more about traffic regulations and road laws than older people has been demonstrated by experiments made by Professor Alvhh R. Lauer, of Iowa State College. Those with more knowledge at any age were found to learn actual driving much more easily. Those most easily trained not only showed superior knowledge, but were more deliberate in their movements and less susceptible to distraction as measured by laboratory tests. "The results seem to emphasize the need for early training in safety to establish proper habits of thinking and action regarding traffic hazards and driving."

DENTAL caries or decayed teeth are more prevalent than any other ailment except the common cold, the U. S. Public Health Service has announced, following a survey of a typical town not far from Washington, D. C. At the age of 15 years, 19 out of every 20 persons have or have had decayed teeth. The figure may be even higher among adults, but the survey was limited to school children. There is as yet no scientific answer, according to the Federal Health Service, to the questions, Why do teeth decay? and How can one prevent their decay? "For the present at least," the services advise, "the best that can be done is to feed the expectant mother, the infant and the child tooth-building foods and to visit the dentist early and often for the control of the extension of dental decay."

SULFAPYRIDINE, the new drug so successfully used in certain cases of pneumonia, has the distinction of being the first drug on which a preliminary survey of its possibilities for good or harm preceded its exploitation. The *Journal* of the American Medical Association states editorially that under the new food and drug act the medical profession has the opportunity of being informed and its representatives consulted about a drug before any preparation is placed on the market. Sulfapyridine was licensed for sale in interstate commerce on March 10. This was done with the full approval of the council on pharmacy and chemistry of the American Medical Association, which sent inquiries to a hundred investigators during the experimental period before the drug was placed on the market. Replies showed the exceedingly great value of the drug in certain cases of pneumonia and also the need for careful supervision of its use. An article on the kidney complications following its use appears in the same issue of the medical journal.

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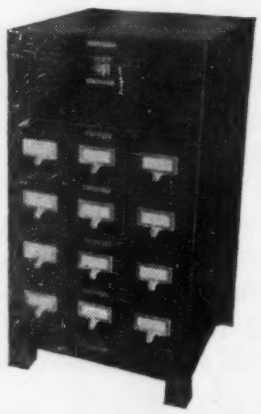

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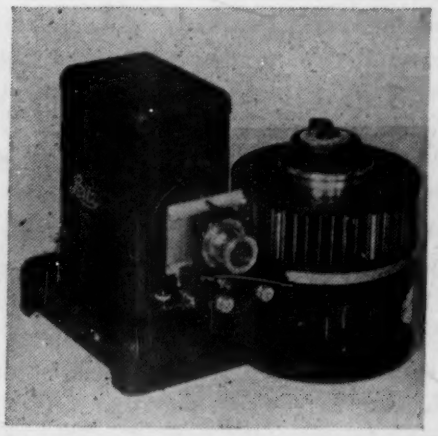

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SCIENCE NEWS

Science Service, Washington, D. C.

THE WAGNER HEALTH BILL

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THE Wagner Bill for a national health program needs revision along the lines of improving existing government medical services to the needy rather than increasing facilities for medical care generally through state and federal financial aid. The type of revision seems indicated by the report on medical care presented by Dr. W. F. Braasch, of the Mayo Clinic, at the meeting of the American Medical Association at St. Louis.

Dr. Braasch's committee found, from replies to a questionnaire sent out by the American Medical Association, that very few persons in the United States are unable to receive medical care if they request it. The questionnaire and survey was not limited to physicians. Social workers, labor unions, industrial organizations, school authorities, relief agencies, hospital and dispensary authorities and public health officials were questioned as well as physicians and dentists.

The replies of these groups were almost completely unanimous. Their statistics and statements covered the medical care situation among 43,000,000 people. The number of Americans lacking medical care is nearer 40,000, these reports show, than the 40,000,000 which government surveys had indicated. The 40,000,000 figure is the basis for the national health conference program for distribution of medical care embodied in the Wagner Health Bill.

The various welfare, relief, health, labor and other groups also all agreed that government care for the medically needy wherever it is supplied is inadequate, except when supplemented by free services of physicians. It seems likely that this report will strengthen the opposition of the association to the Wagner Health Bill.

The survey showed that failure to secure medical care when it occurred was usually due to local conditions. The chief lack in medical care was seen to be in facilities for care of the chronic sick. Solution of the problem is offered by the prepayment plans for medical care now being instituted by many county and city medical societies throughout the country.

Only a few persons replying to the questionnaire, according to the report, recommended compulsory medical insurance, the majority agreeing that changes in local provisions for medical care would be adequate and that such changes should be instituted. Almost all opposed federally instituted changes. The committee report presented by Dr. Braasch has not yet been adopted by the medical association, but was referred to another committee for consideration.—JANE STAFFORD.

THE CAUSE AND CURE OF PHLEBITIS

(Copyright, 1939, by Science Service)

THE cure of phlebitis in ten days by injections of novocaine anesthetic has been achieved by Drs. Alton Ochsner and Michael E. Debakey, of Tulane University School of Medicine, New Orleans. Discovery of the cause of the disease was also announced in their report to the American Medical Association. The condition, characterized by pain, swelling and fever, can occur not only in women after childbirth, but also in patients of either sex following operations. The patients usually are laid up with fever for from four to six weeks and have a swollen leg for the rest of their lives. It was found that the cause of the condition is a spasm of the blood vessels of the lower leg. This had been suggested as the cause of the condition by a scientist named Leriche. Drs. Ochsner and Debakey confirmed this theory by producing phlebitis in animals by constriction of the blood vessels, and by curing the condition in both animals and patients by an operation which relieves the constriction.

The operation consists in blocking the nerves that control constriction of these blood vessels by injections into the nerves of procaine hydrochloride, the local dental anesthetic, known also as novocaine. Pain is relieved immediately after the first injection: In the majority of cases, the fever goes down within forty-eight hours. The swelling is gone in from four to twelve days and most of the patients are out of the hospital and well within twelve days. Nine of the first group of fifteen patients were home in from four to eight days.

Any one who is operated on, Dr. Ochsner explained, gets a decrease in the pulsations of the blood vessels in the feet and lower legs. This means the vessels have a lowered ability to contract and enlarge their bore and as a result the flow of blood through the arteries and veins is decreased. When severe enough, this causes the condition of phlebitis.

The condition is less frequent in the South than in the North and occurs more often in winter than summer, facts which Dr. Ochsner pointed out corroborate the fact that blood vessel spasm by interfering with circulation is the cause of the condition. An early clue to the discovery of both the cause and cure of the condition came when patients with phlebitis were being given heat over the abdomen. The heat cage put over their abdomens happened to be long enough to reach down over part of their legs and to raise the temperature there also. This relieved the condition somewhat, and gave the surgeons an idea of the cause.—JANE STAFFORD.

ANGINA PECTORIS AND CORONARY THROMBOSIS

(Copyright, 1939, by Science Service)

HOPE that such dreaded heart ailments as angina pectoris and coronary thrombosis can be conquered by chemical remedies is held out by discoveries announced by Dr. G. E. Hall, of the University of Toronto, at the meeting of the American Medical Association. The exact chemical that will be used has not yet been determined. It may be atropine, familiar as the "drops" doctors put in your eyes before testing your vision. This drug has shown some life-saving possibilities in dogs with experimental heart disease. More likely, Dr. Hall said, the chemical

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In the seven years since the first edition of "Physical Geology" was published the authors, through use of the book in their own teaching and from discussion with other teachers, came to realize that some parts of the treatment should be recast and strengthened. Furthermore, during these years a large volume of fresh geologic literature has appeared, and distinct advances in several aspects of geology have been made.

The general plan of the book remains unchanged. Two new chapters have been added: Chapter III, which gives particular attention to mass movement of the mantle (this material has been included in order to give greater emphasis to an important phase of gradation, and to make clear the distinction between such movements and the processes of weathering); and Chapter V, in which the sculpturing of the lands by running water and mass movements of the mantle is treated, following a discussion of hydraulic principles and mechanics of stream work in the preceding chapter. All the chapters have been completely reorganized.

Numerous cross-references are employed, in order to coordinate the subject matter and elimnate needless repetition. The practical aspects of geology, such as its relation to soil conservation and industrial developments, are given particular attention. Technical terms have been eliminated as far as seems consistent with effective and clear treatment. Many new reading references are listed, and new field results are cited to illustrate principles. A special effort has been made to improve the illustrations; some of the figures used in "Outlines of Physical Geology," by the same authors, are included, as well as numerous photographs and diagrams that are new.

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treatment used for human heart sufferers will be a combination of atropine with some other drug or chemical. The chemicals must be the kind that can produce results by their effect on certain sets of nerves, because a reflex nerve action, Dr. Hall has found, is probably responsible for sudden deaths from heart disease with or without evidence of the disease of the heart's arteries known as coronary thrombosis. People likely to have a heart attack from mild exertion, cold air, work or anxiety, as is the case with sufferers from angina and coronary thrombosis, probably have a more sensitive reflex nerve mechanism than the average person. Existence of this reflex nerve mechanism was discovered by Dr. Hall in studies of dogs that could be given "heart disease" by cutting off the artery that supplies the heart muscle with blood. The reflex is from the afferent nerves leading away from the heart and producing the sensation of pain in angina, to the vagal nerves that lead to and stimulate constriction of the smaller arteries in the heart's muscle. When this reflex was abolished, either by cutting the pain nerves or by ether anesthesia, the animals with the simulated heart disease had no pain. The deaths were reduced from 75 per cent. to 25 per cent. in the nerve-cutting procedure, and from 50 per cent. to one per cent. when the pain nerves were put out of action by the anesthetic. Atropine abolished the reflex nerve action to some extent, as shown by reduction in pain and in deaths. A Boston surgeon has been getting similar results in human patients, Dr. Hall said, by cutting some of the nerves and thus abolishing the reflex. Dr. Hall hopes that a chemical can be found to accomplish the same end without resort to the hazards of an operation on nerves connected with the heart.

The reflex nerve mechanisem, starting with the pain nerves, causes a spasm of the small blood vessels which cuts down the blood supply to the heart, Dr. Hall believes. In coronary thrombosis this blood supply is already reduced and further reduction is likely to stop the heart completely. Sudden and often fatal heart attacks in patients who have not had coronary thrombosis is probably caused by a spasm set up by the same reflex nerve mechanism.—JANE STAFFORD.

THE SOURCE OF COSMIC RAYS

(*Copyright, 1939, by Science Service*)

A COSMIC "tortoise and hare" race in inter-galactic space is suggested as the origin of the piercing "hard" cosmic radiation which comes down through the earth's atmosphere to strike every person on earth.

In a report to the American Geophysical Union meeting in Washington, Dr. Thomas H. Johnson, of the Bartol Research Foundation of the Franklin Institute, described the tortoise-hare race. According to this report, there is in the universe a source of cosmic rays which is emitting high-speed electrons in a fashion somewhat comparable to the emission of electrons from a vacuum tube filament in a radio set. These electrons, carrying a negative electrical charge, leave the source of cosmic rays charged positively. The more electrons go off the more the source becomes positive.

There is a dual effect of the positive charge: It acts as a brake on the fast electrons and eventually slows them down, and, at the same time, it speeds up any positively charged ions floating in inter-galactic space. These ions may be protons (the ions of hydrogen atoms) or ions of even heavier elements. Positive electrons, too, would be accelerated. Thus, as the race goes on, the massive ions (the slow tortoises) start to speed up and the swift hares (the electrons) start to slow down. At some point, far out from the source of the cosmic rays, the speeds of the electrons and the speeds of heavier ions will be equal. At this point, however, the energy possessed by the heavy ions will be nearly two thousand times as great as the energies of the electrons.

Cosmic ray studies near the top of the atmosphere with radio sounding balloons disclose that the soft component of cosmic rays—which never are detectable on earth—are formed by charged particles about equal in number. These, it is pictured, are the "weakened" electrons and positrons striking the atmosphere.

The hard component of cosmic rays, however, apparently is formed by highly energetic positively charged particles. It is the hydrogen ions—or even more massive charged atoms—which Dr. Johnson believes cause the hard component of cosmic rays found on earth.

These "hard" rays are now known to be the mesotrons, particles having a mass intermediate between protons and electrons. That mesotrons are formed in the top of the atmosphere by impacts with primary rays from the outside is known, Dr. Johnson said, because the mesotrons are particles whose half life is only about one two-millionth of a second.

Traveling at nearly the speed of light, they have time to get down through the earth's atmosphere, but their short life makes it virtually impossible for them to originate at any distance outside the earth's belt of air.—ROBERT D. POTTER.

CATALYSTS

LIKE a mediator in a labor dispute who draws employer and employees together in settling a strike, a catalyst in a chemical reaction draws incompatible molecules together and makes them carry out reactions more easily and quickly than is otherwise possible. But how a catalyst is able to do this is one of the mysteries of chemistry.

New discoveries announced by Professor Victor K. LaMer, of Columbia University, however, indicate the nature of liquid catalysts' potent power. Working with Drs. Edward S. Amis and Hazel M. Tomlinson, Professor LaMer's investigations should return thousands of dollars to America's chemical industry yearly.

Better catalysts means speedier reactions. This means greater chemical production without additional outlay in capital plant structures. A better understanding of the nature of liquid catalysts also means an inhibition of chemical reactions that destroy valuable products in such important fields as the making of soap, smokeless powder, lacquer, solvents and a host of other products.

Electricity, it is found, is the powerful tool of "negotiation" in the catalyst's rôle of making unwilling chemicals react. Molecules having like electrical charges upon them, normally dislike to react because there is a repulsion between them. If a liquid catalyst having the opposite electrical charge is brought up to them, how-

THE SCIENTIFIC MONTHLY

J. McKEEN CATTELL, F. MOULTON and WARE CATTELL, Editors

CONTENTS FOR JUNE

GROWTH OF ASIA. PROFESSOR BAILEY WILLIS.

APPLICATIONS OF SCIENCE TO THE METALLURGICAL INDUSTRY. DR. JOHN JOHNSTON.

UP MOUNT KINABALU. II. JOHN A. GRISWOLD, JR.

THE ORIGIN OF LIBERTY. PROFESSOR WALTER WOODBURN HYDE.

EPIC OF LIFE. DR. OSCAR RIDDLE.

THE LAND AND THE PEOPLE. H. H. BENNETT.

EMILE JAVAL—FRENCH SAVANT. DR. JAMES E. LEBENSOHN.

"WHENCE COMETH LIFE?" PROFESSOR WILLIS R. HUNT.

EMINENT MEN. PROFESSOR MAPHEUS SMITH.

BOOKS ON SCIENCE FOR LAYMEN:

This Earth of Ours; Plants and Animals of the Desert; The Story of a Century; Nature—in One Book.

THE PROGRESS OF SCIENCE:

Dr. Frank B. Jewett, President of the National Academy of Sciences; Annual Meeting of the National Academy of Sciences; Milwaukee a Mecca for Scientists in June; Biology at the New York World's Fair; Bok Photographic Museum of the Franklin Institute; Aeronautical Research and Development.

INDEX.

CONTENTS FOR APRIL

HUMAN NEEDS AND SOCIAL RESOURCES. PROFESSOR C. MACFIE CAMPBELL.

NATURAL HISTORY OF SANTA CATALINA ISLAND. PROFESSOR T. D. A. COCKERELL.

BEHAVIOR AND SOCIAL RELATIONS OF FREE-RANGING PRIMATES. PROFESSOR C. R. CARPENTER.

PARTICLES OF THE COSMIC RAYS. DR. KARL K. DARROW.

A BIBLIOGRAPHER TURNS DETECTIVE. DR. E. W. GUDGER.

LACEWINGS AND THEIR ALLIES. DR. LEE H. TOWNSEND.

CAUSES OF VIRUS DISEASES IN PLANTS. DR. MELVILLE T. COOK.

CHLOROPHYLL—ITS FUNCTION. DR. FRANK MILTON SCHERTZ.

A COMPASS FOR MANKIND. D. S. BURCH.

BOOKS ON SCIENCE FOR LAYMEN:

Weather in Words and Pictures; Practical Science in the Home; Some Facts of Science Oversimplified; Not Much About Petroleum; Big Fleas Have Little Fleas.

THE PROGRESS OF SCIENCE:

Meeting of the Australian and New Zealand Association for the Advancement of Science; Award of the Faraday Medal to Dr. W. D. Coolidge; William Bartram's Bicentennial; James Playfair McMurrich; Hard Copper—Cupaloy; "Inferior" Children in Superior Homes; Sleep Longer.

CONTENTS FOR MAY

DRUG ADDICTION AS A PUBLIC HEALTH PROBLEM. DR. LAWRENCE KOLB.

UP MOUNT KINABALU. I. JOHN A. GRISWOLD, JR.

LITTLE-KNOWN FOSSILS. CHARLES T. BERRY.

THE IONOSPHERE. DR. E. O. HULBURT.

MAN'S CREATIVE YEARS IN MUSIC. PROFESSORS HARVEY C. LEHMAN AND DEFOREST W. INGERHAM.

NEW DEVELOPMENTS IN SCIENCE MUSEUM TECHNIQUES AND PROCEDURES. ROBERT P. SHAW.

THE POLICEMAN ON THE BEAT? PROFESSOR READ BAIN.

GREAT LANDED ESTATES IN THE MEDITERRANEAN REGION. DR. RAYMOND E. CRIST.

CULTURE AND CIVILIZATION IN GUATEMALAN SOCIETIES. SOL TAX.

BOOKS ON SCIENCE FOR LAYMEN:

Alcohol and the Individual; The Golden Plover and Other Birds; The Heavens Again; Controlling "Indoor Weather."

THE PROGRESS OF SCIENCE:

Science and the New York World's Fair; The Centennial of Photography; Award of the Nichols Medal to Professor Hildebrand; The Velocity of Light; The Great Anteater Group at the Field Museum; Composition of Gaseous Nebulae; A New Explanation of Submarine Canyons.

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ever, the attractive forces created can overcome the repulsion. If the unwilling molecules come close enough the chemical reaction can occur, and the catalyst, unharmed and unchanged, is ready to do its job of negotiating between the next pair of antagonists.

A FRENCH STREAMLINE CAR

(*Copyright, 1939, by Science Service*)

THAT France now has a light-weight motor car which can do 53 miles to the gallon of gasoline when running at 30 miles per hour, was reported to the World Automotive Engineering Congress meeting in New York City by French engineers J. Andreau and Charles B. Brull. At 50 miles an hour it will get 49 miles to the gallon of fuel and 39 miles to the gallon at 70 miles per hour. Even at speeds of 90 miles an hour it obtained 27 miles to the gallon of fuel.

This car, a streamlined version of the popular Citroen, seats five people and has a top speed of 93.5 miles an hour. Compared with a stock car having the same motor its performance showed half the gasoline consumption coupled with a 45 per cent. increase in speed.

Engineer Andreau is the designer who turned out the body of the famous "Thunderbolt" of Captain Eyston which holds the world's land speed record of 357.5 miles an hour.

In cars with the new Andreau body the hissing of the wind against the body is completely suppressed and the driver loses this criterion of speed. So efficient is the streamlining that the windshield remains completely clear. There is no frontal air pressure upon it to stick mud or insects to the glass panels. Rain drops run from the bottom to the top of the windshield and are instantly scattered so that no wiper is needed. There is no sidesway due to lateral wind and the stability is so great that the steering wheel has true finger tip control.

The economics achieved with such streamlining, even at ordinary driving speeds, are the engineers' answer in Europe to the severe taxes on motor fuel and on cars.

ITEMS

WE, meaning the earth, the other planets and the sun, are hurtling through space at about 180 miles a second toward a point on the north side of the Milky Way, Dr. Edwin Hubble, Mount Wilson Observatory astronomer, announced in connection with receiving the prized Franklin Medal of the Franklin Institute. The sun with its planets, according to the best theory, is rotating around the center of the Milky Way, as our galaxy of many thousand million stars is called, at a velocity of about 165 miles per second. With respect to the outside galaxies, seen as nebulae with powerful telescopes, Dr. Hubble finds that our own galaxy or Milky Way, consisting of a great system of stars, has a velocity of the general order of 60 to 120 miles per second in the general direction of higher north galactic latitudes. The motion through space of the sun, with the earth, is a composite of its motion in the galaxy and the motion of the galaxy itself. Dr. Hubble based his estimates of these motions on the extensive studies of the universe he has undertaken with the 100-inch telescope on Mount Wilson.

A SURVEY of major allergic manifestations in Colorado Springs, Colo., shows that 22.6 per cent. of the general population have one or more major ellergic manifestations. The following incidences were found: Hay fever, 10.06 per cent.; asthma, 3.6 per cent.; eczema, 2.9 per cent.; migraine, 3.7 per cent.; urticaria (hives), 3.2 per cent.; gastro-intestinal allergy, 3.3 per cent. A positive family history of major allergy was obtained for 35.7 per cent. of the subjects with major allergy. Approximately 16 per cent. of the allergic persons presented more than one major allergic manifestation. Dr. W. C. Service, of Colorado Springs, presents the results of this study in the *Journal* of the American Medical Association.

DR. IRVING S. WRIGHT, of New York, has found that people can get scurvy even if they are eating enough of the scurvy-preventing vitamin C. This apparent paradox is explained by the fact that a certain type of colitis, drastic catharsis and excessive use of alkalis such as soda bicarbonate may, any one of them, prevent absorption of vitamin C from the fruits and vegetables eaten. Dr. Wright's studies, announced to the American Medical Association, are the first to show this fact conclusively. He has also devised for the first time a method for determining whether or not the body tissues are absorbing vitamin C from foods satisfactorily.

CANNED heart beats of cardiac patients can now be preserved and heard phonographically at will through loud speakers, thanks to the device developed by a George Washington University Medical School junior, Edmund Ziman. Specialists who have used the new method foresee that it will make diagnosis of heart ailments more accurate. In difficult cases the physician can take a recording of the patient's heart and study it carefully, hearing it repeatedly. The heart sound records can also be used for teaching purposes and research.

THE highly destructive epidemic that has almost wiped out the sponge fisheries of Bahama-South Florida waters appears to have been due to a fungus-like organism, according to a report in *Nature*, signed by an international investigating committee composed of Paul S. Galtsoff, U. S. Bureau of Fisheries, and Hubert H. Brown, C. Leslie Smith and F. G. Walton Smith, Sponge Fishery Investigations, Nassau, N.P., Bahamas. The threads of the fungus-like organism were found in the flesh of sick and dying sponges, but not in healthy sponges or in those long dead. It does not seem to affect other forms of marine life.

COTTON may hit back at wood, which has taken a good deal of its business away *via* the rayon route, it was suggested at the recent meeting of the Virginia Academy of Science at Danville. Synthetic insulating lumber has been made out of pulped whole cotton plants, according to Herbert T. Bates and Professor Frank C. Vilbrandt, of Virginia Polytechnic Institute. The cotton plants, bolls and all, were pulped in a laboratory rod mill and the pulp squeezed between heated plates in a hydraulic press. The material thus made came out satisfactorily in tests for strength, density and heat insulation.

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SCIENCE NEWS

Science Service, Washington, D. C.

MENTAL ILLNESS AND DEFECT

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DR. ROCK SLEYSTER, of Wauwatosa, Wis., in his presidential address at the St. Louis meeting of the American Medical Association, pointed out that mental illness and defect are the next great plagues in line for attack by medical men. Hand in hand with the attack on these problems will come an understanding of man's mind to help solve problems of government.

"One by one the great plagues that used to devastate mankind are being overcome," he said. "No longer does civilized man live in constant fear of cholera, smallpox and bubonic plague. Typhoid fever has become so rare that many a modern physician has never seen a case of this disease. . . . In our own time we have seen arsphenamine for syphilis, insulin for diabetes, liver for pernicious anemia, biologic preparations for pneumonia and scarlet fever, sulfanilamide and sulfapyridine for streptococcic and pneumococcic and similar infections. . . . We have seen the life expectancy rise from 40 years at birth to 62 years. What fields remain to be conquered? Among the problems which yet confront us, mental defect and mental disease are increasingly significant. They are imposing in their scope. An understanding of the human mind and of human thinking may aid in the solution of problems of government."

The 1,300,000 Americans who, Dr. Sleyster estimates, are on any one day incapaciated by epilepsy, feeblemindedness and various types of mental illness, constitute a problem which it is directly up to physicians to solve. Besides this, there is the problem of how to oppose the forces which tend to sap the vitality of men and women, destroy their initiative and break down individual character.

"The citizen of the United States in Revolutionary times was a hardy pioneer who had fought the forces of men and of nature successfully and who knew where he wanted to go and what he wanted to do," Dr. Sleyster pointed out. "To-day the forces that have been developed by man as a result of modern invention in the field of both materials and of thought are so intricate and so great that frequently they are far beyond the ability of the average man to grasp. Hence bewildered, little men seek constantly for leadership without even sufficient data or background to determine whether or not the leadership is for good or evil."

It is the responsibility of the physicians and of the nation to see that, as a consequence of this situation, people do not pay too great a price, in breakdown of character, for security in old age, medical care and insurance against unemployment. Granting that not all the people possess the benefits of "American life and living," which are enjoyed by the majority, Dr. Sleyster said that the same forces which brought us to our present high standards of health and living should enable us to extend these benefits to those who have not yet enjoyed them. To this purpose the American medical profession has repeatedly dedicated itself. He added that as president of the American Medical Association for the coming year he proposes to devote himself primarily to this task of "doing all that can be done to spread more widely the benefits of American life and living."—JANE STAFFORD.

ANALYSIS OF WAGNER HEALTH BILL BY A COMMITTEE OF PHYSICIANS

WARNING against "niggardly" financial provisions in a national health program was sounded at a recent Senate subcommittee hearing on the Wagner Health Bill. The warning came from the Committee of Physicians for the Improvement of Medical Care, Inc., formerly known as the Committee of 430 Physicians.

The $10 per capita per annum proposed in the report of the Technical Committee, whose work preceded the Wagner Bill, as the cost of a national health program is too low to insure good quality of medical care, the Committee of Physicians believes. According to the statement of the committee, it has "felt constrained to adopt an uncompromising attitude towards projects or measures that obviously violate the fundamental ends for which they have united, namely, the protection and improvement of the quality of medical care.

"To embark upon a program that contemplates the expenditure of only $10 per capita per annum, when this is obviously inadequate, would inevitably sacrifice quality to mere distribution.

"Experience of non-profit organizations already engaged in providing medical services indicates that, under private auspices, full medical care of acceptable quality costs more than $20 (possibly nearer $30), *per capita per annum.*

"Any attempt to introduce compulsory health insurance widely at this time is viewed 'with disfavor.'"

Voluntary sickness insurance should be encouraged, the committee believes. Even though it can not be expected to solve all the medical problems of those just above the level of true need, it will assist many to meet their financial obligations. Group medical practice "properly organized at the initiative of physicians or consumers" is considered a good method for coordinating all the necessary components of medical care which might be provided under a health and medical care program. "Such group activities for the care of the needy could well be centered about hospitals and diagnostic and therapeutic centers. Full correlation with existing public health services must also be provided."

If all concerned direct their concerted efforts toward developing a program that would assure the highest quality of care, the committee believes the two vexatious problems of distribution of authority and administration could be solved.

ATOMIC ENERGY AND CHEMICAL REACTION BY HEAT

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EASTMAN ORGANIC CHEMICALS

from the splitting of uranium has been made to create a chemical reaction for the first time, according to a report in the current issue of *The Physical Review*.

Investigators at New York University have demonstrated that nitrogen iodide can be made to explode when placed near uranium that is being split by bombardment with neutrons.

The chemical action thus set off is believed caused by the heat released from the splitting uranium atoms. Chemically the reaction is without practical or commercial importance because nitrogen iodide is known to be a very unstable compound which will explode if dropped or otherwise carelessly handled. However, the experiment is perhaps a historic one in this field of research.

Dr. Eugene Feenburg, theoretical physicist, devised the experiment, which was carried out by Professor Walter A. Schneider and R. C. Waddel, of New York University, and Dr. Dixon Callihan, of the College of the City of New York.

In other studies made on the problem of the nature of energy released from uranium, Drs. E. T. Booth, J. R. Dunning, G. N. Glasoe, F. G. Slack and J. Steigman, of Columbia University, reported:

1. The fission products of uranium splitting fly off sufficiently to pierce 2.2 centimeters of air, nearly an inch. Another group, having a range of 1.5 centimeters, was also noted.

2. Two gaseous products (yet unidentified but perhaps inert gases like krypton and xenon) are given off when uranium is split. Both these gases seem to be radioactive with a half-life decay of 35 seconds and five minutes respectively. The short-lived gas is apparently created when barium is produced as the other splitter particle. The chemical element associated with the longer-lived gas seems to be rubidium.

3. The sum of the energies of the two splitter particles sums up to a total of 175,000,000 electron volts. This is considerably less than the 200,000,000 electron volt energies predicted for the fission process by theory. The difference is probably due to considerable energy being used for the excitation of the splitter fragments which results in the emission of neutrons, gamma radiation and electrons.

DANGERS THT MENACE SUBMARINE CREWS

(*Copyright, 1939, by Science Service*)

THAT the men who go down to the bottom of the sea in ships are called on to face five varieties of danger to which men on surface ships are not exposed at all or not in the same degree, is shown by a survey looking back through thirty-seven years of submarine disasters.

They must face danger of suffocation from exhausting the underwater vessel's supply of oxygen. They are menaced by carbon dioxide, generated in their own bodies and exhaled from their lungs, poisonous when its concentration in the air passes a certain point.

Sea water can turn the electricity-generating chemicals of the storage batteries that power the electric motors for underwater operation into generators of deadly chlorine gas, the first of the World War's poison fumes.

Collision is more of a menace to submersible craft than to surface ships, as the record shows, because a submarine has practically no reserve buoyancy, unlike ordinary vessels. If it had, it would not dive when its ballast tanks were filled. So if collision breaks open more than one of its compartments, its staying afloat would be something of a miracle. Many specially designed surface ships can stay right side up and on top of the water with several compartments flooded.

Ever present, also, is the danger of a failure in the pumping system for forcing water out of the ballast tanks. The tanks are filled to dive. Akin to this menace is the never impossible failure of a valve or a hatch to stay closed when the ship is below the surface; or of a submarine going down with one or more of its inlets open. This latter has happened particularly when the ship sank quickly after being rammed.

Oxygen tanks are carried on submarines to provide enough of the life-giving gas to last between 72 and 100 hours. When trapped on the bottom, crew members stay as still as possible in order to conserve the precious supply. Oxygen consumption increases with one's physical activity. The tanks are generally set to release the gas when its concentration goes below 21 per cent.

Soda lime is carried on all submarines to absorb the carbon dioxide the men breathe out. It is put in the mechanical ventilating system, and if that fails it is scattered about the ship. Half a pound per man per hour is needed. Gas masks are carried to protect the sailors against the chlorine danger. Seawater reaches the batteries as a result of collision or, possibly, as a result of failure to close a valve or a hatch. Chlorine is blamed for the loss of 60 men aboard the British submarine *M-2* on January 26, 1932.

Carbon monoxide from gasoline engines used for driving the ships while they were on the surface used to be a serious hazard, but it is no longer because Diesel engines are now used in place of gasoline motors.—LEONARD H. ENGEL.

ITEMS

A WATERFALL three times the height of Niagara will begin to pour and roar about four years from now. It will be an artificial cataract, the spillway of the new Shasta Dam in the Sierra foothills, and will have a height of 500 feet above low-water level. Shasta Dam, which is part of a project to quadruple the area under irrigation in the Sacramento-San Joaquin Valley, and also to insure a constant year-round flow in the Sacramento River, is described in the new issue of the *Geographical Review*, published by the American Geographical Society.

DR. JOHN G. BELLOWS and Herman Chinn, of Northwestern University Medical School, have found that fifteen minutes after the first dose of sulfanilamide is given by mouth it can be detected in all the tissues, even the fluids of the eye. The ready penetrability of all tissues thus far examined to sulfanilamide is an important factor in its efficiency in treatment. Encouraging reports have already been made of the effects of the new drug in the eye for trachoma, gonorrheal ophthalmia, orbital cellulitis and abscess of the lid. Streptococcic infections in rabbits' eyes have been successfully treated with sulfanilamide, but thus far little work has been done on the penetration of this compound into the eye.

Forthcoming Books for Fall Courses

Propagation of Horticultural Plants

By GUY W. ADRIANCE and FRED R. BRISON, Texas A. & M. College. *McGraw-Hill Publications in the Agricultural Sciences.* In press—ready in September

In this book the reproduction of plants, for commercial or home planting, is considered from two viewpoints: (1) production of seeds and growing and handling of seedlings; and (2) the various methods of asexual propagation, involving the use of plant parts. Forcing structure and other equipment necessary in the growing of plants are illustrated and described. The most recent practices relative to the propagation of specific plants are included.

The Management of Farm Woodlands

By CEDRIC H. GUISE, New York State College of Agriculture, Cornell University. *The American Forestry Series.* In press—ready in September

This book provides the technical information required in the solution of the problems of woodland management and in stimulating good silvicultural and utilization practices. The material is applicable to the farm woods of several acres as well as to the larger woodlands not sufficiently extensive to be included in commercially operated forests. Although the book has been prepared with the eastern United States especially in mind, the principles will apply throughout the entire country.

History of Chemistry. *New third edition*

By the late F. J. MOORE. Revised by WILLIAM T. HALL, Massachusetts Institute of Technology. *International Chemical Series.* In press—ready in September

As before, this book gives a treatment of the historical development of the important theories of chemistry which covers the origin of the fundamental ideas of the science, their philosophical basis, the critical periods in their development, and the personalities of the great men who have contributed to that development. In the new edition equal emphasis has been given to all phases of chemistry; more attention is paid to the work of American chemists; and greater stress is placed upon recent progress in the field.

The Photographic Process

By JULIAN ELLIS MACK and MILES J. MARTIN, University of Wisconsin. In press—ready in July

The authors of this book give a unified modern treatment, presented simply enough for the general student, yet with sufficient rigor to justify its use in a course in photography for students in such fields as science, archaeology, art, and journalism. The manual, which is a separate part of the book, gives working directions for a variety of specialized operations. The illustrations, both pictorial and scientific, are an outstanding feature of the book.

Matter, Motion and Electricity. A Modern Approach to General Physics

By HENRY D. SMYTH, Princeton University, and CHARLES W. UFFORD, Allegheny College. In press—ready in July

In this distinctive new book, intended primarily for students with a background of high school physics, the authors' purpose has been twofold: (1) to review fundamentals and definitions sufficiently to insure a solid base on which to build; and (2) to present the subject from a fresh approach that avoids a repetition of the conventional beginners' course. Modern developments are introduced early and often, stimulating the student to apply analytical reasoning and judgment to physical problems.

The Principles of Sedimentation

By W. H. TWENHOFEL, University of Wisconsin. In press—ready in September

This book deals with the sources of sediments; the environmental factors that influence their production, transportation, and deposition; the various methods by which sediments are transported from source to site of deposition; the various products which result from operation of sedimentary processes; and the various structures which arise as a result of deposition. Emphasis is placed on the fact that sediments are products of heritage and environment.

Electricity and Magnetism. An Introduction to the Mathematical Theory

By JOHN B. WHITEHEAD, Johns Hopkins University. *Electrical Engineering Texts.* In press—ready in September

The purpose of this book is to provide a compact development of the physical theories of electricity and magnetism, beginning with the simplest manifestations of mechanical force by electrostatic and magnetic phenomena. The subsequent treatment is chronological with uniform development of the mathematical relations. Descriptive matter has been reduced to a minimum. The electron theory of matter is introduced qualitatively at all points possible. There is an unusually thorough treatment of polarization in dielectrics.

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SCIENCE NEWS

Science Service, Washington, D. C.

SUPERNOVA FOUND IN DISTANT NEBULA

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DISCOVERY of a gigantic celestial explosion, a supernova, or star that has flared in a far distant nebula to extraordinary brilliance, probably hundreds of thousands that of the sun, has been made by Dr. Fritz Zwicky while observing on Mount Palomar, Calif., where the 200-inch telescope is being erected.

This newly-discovered outburst is located in the elliptical nebula known as NGC 4621, a member of the Virgo cluster. It is about 15th apparent magnitude, which means that it can be seen only with a powerful telescope. Identification of it as a supernova was made from a spectrum obtained at Mount Wilson Observatory, and Dr. Walter S. Adams announced the discovery by communicating the information to Harvard College Observatory, the clearing house for astronomical information. This supernova is only the nineteenth reported in astronomical history. Dr. Zwicky has made a special search for supernovae and during the past few years has found several.

Famous among the rare supernovae of the past is Tycho's star, which appeared in November, 1572, and was for some days visible in daylight and brighter than Venus at her best. Another temporary star, observed by Kepler in 1604, was as bright as Jupiter and remained visible for two years. These were much closer to the earth than the supernova just discovered by Dr. Zwicky and were therefore seen by the unaided eye. More frequent are temporary or "new" stars giving out less light. These ordinary novae are not in the same class with the supernovae. But they attract much attention, both on the part of lay observers of the stars and the astronomers. Nova Herculis, which burst forth shortly before Christmas, 1934, was a spectacular ordinary nova.

Scientists speculate on what remains of novae when they fade away. One suggestion is that they become stars consisting of neutrons with no ordinary matter in their make up. The neutron is one of the basic building blocks of matter and it was discovered in 1934. Such a spent star of neutrons would be extremely dense. The earth's mass on the same density would be a ball less than two miles in diameter.

The outburst of a nova transcends in magnitude all other known physical catastrophes. Astronomers do not know just what happens. Favorite among theories is that there is a tremendous release of energy within the atoms of matter composing the star. Another suggestion is that novae occur when two stars collide.

TOOTH DECAY CAUSED BY DRINKING WATER

(Copyright, 1939, by Science Service)

DRINKING water may be a weapon of to-morrow for fighting and conquering tooth decay or dental caries. This possibility looms as a result of a "startling finding" reported by Dr. H. Trendley Dean and his associates of the U. S. Public Health Service.

The amount of tooth decay among school children is not the same in one town after another, as might be expected. There was double and treble as much found among children in two Illinois cities, Macomb and Quincy, for example, as in the near-by cities of Galesburg and Monmouth. The difference, it appears, is related to differences in the water supplies, and particularly to differences in the amounts of fluorine in the drinking water.

Fluorine in drinking water is the cause of the ugly tooth condition of mottled enamel. But in Galesburg and Monmouth, where the water contains 1.8 and 1.7 parts per million of fluorine, the threshold of safety for mottled enamel, the children's teeth showed much less decay than in the towns of Macomb and Quincy where the drinking water contained only 0.2 parts per million of fluorine.

Dr. Dean is not yet ready to advise adding fluorine to drinking water to prevent tooth decay. Before recommending such a step he wants more evidence to show that it is the fluorine and not some other constituent of the drinking water that makes the difference in the amount of dental decay. But he called the latest findings "startling" and said that they showed the drinking water may be "deucedly important" in connection with the tooth decay problem.

Dental caries, or tooth decay, is second only to the common cold as the commonest of mankind's ills, affecting at least 19 out of 20 persons.

GRASSHOPPERS AND DRY WEATHER IN THE NORTHWEST

(Copyright, 1939, by Science Service)

WAR between man and grasshopper hordes in the West is getting down to grim grips, according to field reports received at the U. S. Department of Agriculture. To the northwestern grain and range states particularly, where dry weather during the present month has favored the enemy, it has been necessary to send in heavy supplies of poison ammunition.

Shipments totaling 5,300 carloads, or 107,000 tons, of bran-sawdust-arsenic bait have gone to 1,000 points on the battlefront in the five states of Montana, Wyoming, the Dakotas and Minnesota, where the grasshoppers have been observed emerging from the ground "by the billion."

Normally, the young grasshoppers do not crawl far from their hatching areas, but content themselves with feeding on the near-by vegetation. However, drought this spring has stunted plant growth, and shortage of supplies may cause them to begin mass flights as soon as they have matured and grown their wings. It is for this reason that the entomological chemical-warfare squads are laying down poison-bran barrages as fast as they can.

Hatching has been general farther south, to the Mexican border and west to California. In some unfortunate spots in New Mexico and Arizona, 70 per cent. of the eggs in the soil have produced young grasshoppers. Populations of the insects as high as 1,500 per square yard have been counted in these spots.

Heavy shipments of poison bran-sawdust bait have already been made to these more southerly threatened points. But all this costs money, and the 'hopper-fighters would rather see rain do their work for them. Rain helps in two ways: indirectly, by causing better growth of food plants, thus immobilizing the hordes; and directly, by battering the young insects into the ground and killing them or by encouraging the growth of fungus diseases that decimate their ranks.

PLANT SEX HORMONES IN A LOW FORM OF WATER FUNGUS

(*Copyright, 1939, by Science Service*)

FOUR different hormones, created and acting in sequence, control the preliminary sex functions in a newly discovered species of fungus water mold, a very primitive plant form, according to Dr. John R. Raper, fellow of the Harvard Biological Laboratories.

Sex hormones have been studied for many years in human beings, animals, and higher plants, and there have been a few indications that such substances operated in low plant forms. But the activity of sex hormones in a plant have not been shown clearly and conclusively until Dr. Raper's work.

Two of the four hormones observed by Dr. Raper arise in the female plant, and initiate responses in the male plant; the other two hormones are produced by the male and initiate responses in the female. The hormones are known as "diffusion hormones," originating in plants of one sex and spreading through the water to plants of the other sex.

In his elaborate and delicately controlled tests, extending over two years, Dr. Raper determined that the hormonal activation and coordination of reproduction in the water mold is exercised as follows: hormone "A" arises from the female plant, is carried to the male plant through the water habitat, and induces the formation on the male plant of shoots, known as antheridial branches; hormone "B" arises from these new male branches, diffuse to the female plant, and gives rise there to small bulbs, known as oogonial initials, which afterwards contain the egg cells; hormone "C", arising from the female bulbs, attracts the male branches into contact; hormone "D" arises from the branches and delimits the female plant bulb. Reproduction of the water mold is rapid when male and female plants are placed in the same culture; but the plants are sterile when the sexes are separated.

Dr. Raper emphasized that his findings apply only to certain low forms of plant life, and perhaps not to other low forms or to higher more complex forms, such as flowers and trees. It may well be that the reproductive cycles of other low forms and the higher forms have entirely different controls from those observed in the water mold.

His work provides ground for belief that at some points the functions of sex hormones in the water mold are quite similar to those in animal forms. It was shown that in the primitive water mold the hormone control of the reproductive cycle is extremely complex, as it is in the higher animals.

LIFE-SAVING FUNCTION OF TONGUE

YOUR tongue saves your life, Dr. Curt P. Richter, of the Johns Hopkins Hospital, pointed out at the American Neurological Association meeting in Atlantic City on June 5. Not only can it save you from swallowing poisons, but the tongue and its taste buds can guide your selection of foods so that you will get all the life-essential elements of diet, from salt to vitamins.

"The tongue is the watchdog of the diet," Dr. Richter said, "but dietitians and doctors have largely neglected it in their consideration of human diets."

The tragic story of a three-year-old baby girl whose craving for salt was not recognized as a vital demand of her body until too late to save her life was a dramatic example of the importance of the tongue as a guide to diet that occurred coincidently with Dr. Richter's innumerable tests of rats' tasting abilities which were the actual basis of his report.

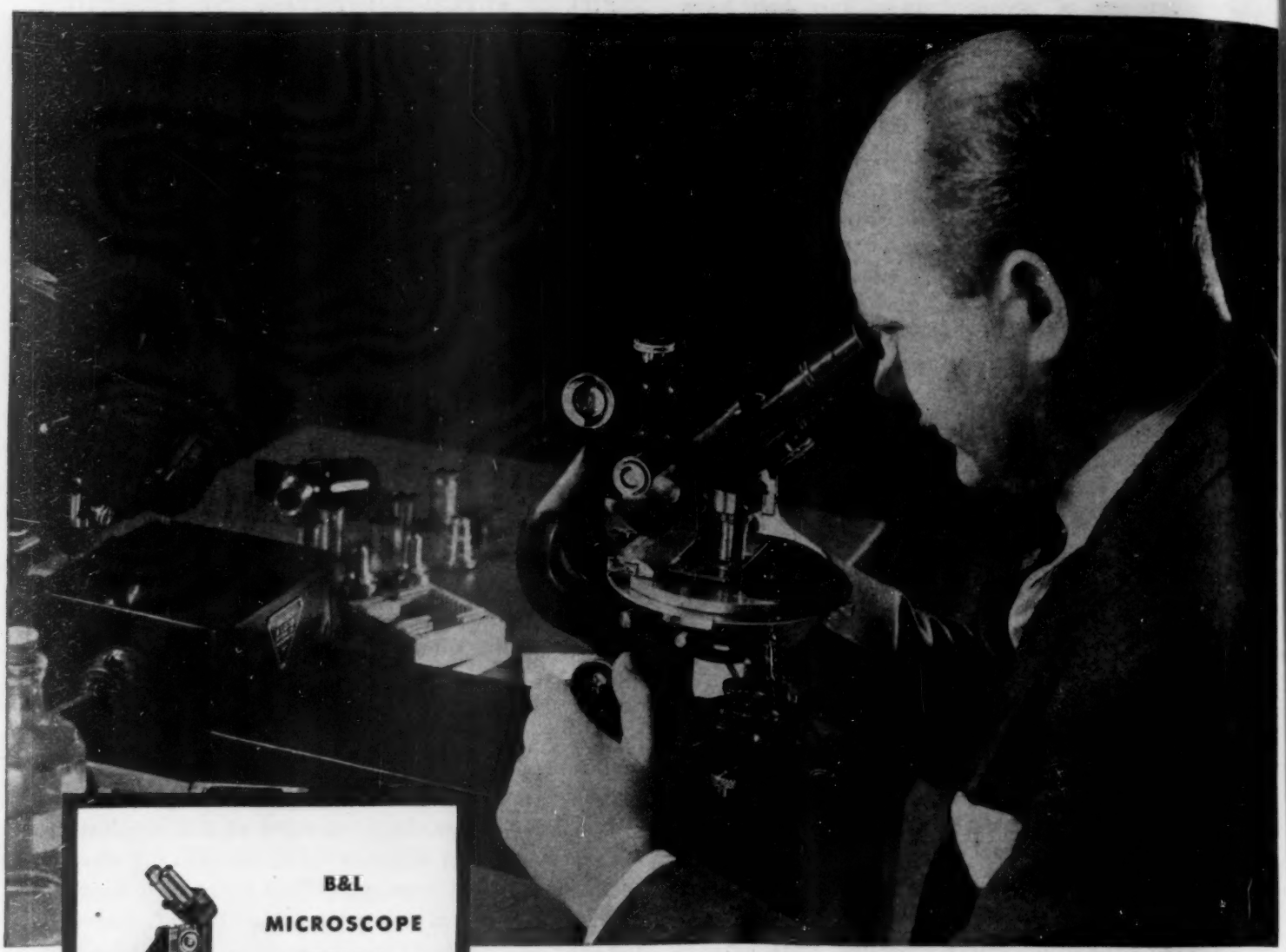
The little girl was brought to the Johns Hopkins Hospital from Florida to find why she was growing up too fast, with precocious sexual development. While in the hospital she was given the dietetically correct food for her age. After her death, it was found that a tumor of the adrenal glands was responsible for the sexual precocity. More than this, it had crowded out the vital outer part of these glands, causing a condition like that in the once-fatal Addison's disease.

In this condition, large amounts of salt are lost from the body and must be made up in the diet. Because the condition had not been recognized before her death, the child was not given any extra salt. But afterwards her mother reported that the child had for a long time craved salt, eating it by the handful, as most children like to eat sugar. This same condition in rats helped Dr. Richter to discover the vital importance of the tongue and its taste buds. Rats, he has found, can tell the sweetness, sourness, saltiness and many other flavors of foods or drinks. They tell it by taste.

This was proved when the animals lost their tasting ability after all nerve connections were cut between the taste buds of the tongue and the brain centers. So long as some of the nerve connections remained the animals could detect different tastes.

The rats that had no adrenal glands, for example, could detect salt well enough to save themselves from death by drinking all the salt water they needed. When all the nerves were cut, however, taste was completely destroyed. The animals drank indifferently from either salted or unsalted water supplies. They thus failed to get enough salt and died. Taste guides the animals not only to enough salt. Normal rats, relying on taste alone, can select as good a diet for themselves, with the necessary amounts of fat, sugars and starches, proteins, minerals and vitamins, as scientists with all their knowledge can provide. Dr. Richter discovered this when he supplied the animals with a wide variety of food substances and let the animals help themselves.

When he gave them a diet lacking in any essential, vitamin B for example, and supplied this in a tube of



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water identical with the drinking water tube, the animals invariably drank enough of the vitamin B water, although the only way they could tell it was by the taste.

BERYLLIUM WHICH IS LIGHTER AND STRONGER THAN ALUMINUM

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THE Temporary National Economic Committee in its hearing on the newborn beryllium industry is slipping back the curtain for a glimpse at a coming revolution in metal, for whose control potent industrial interests are already maneuvering.

Not one person in a thousand has ever seen a sample of the metal itself or of an alloy containing it, but beryllium, two thirds as heavy as aluminum and several times as strong, may produce greater changes in the next ten years than aluminum in the last thirty.

The use of beryllium thus far has been held back by costs which, until only a few years ago, were prohibitive, but with the price dropping—it is now $15 a pound for beryllium in the form of an alloy with copper—engineers and metallurgists all over the world are putting it to work.

Its enormous tensile strength and, in the form of an alloy of about three parts of beryllium to one of aluminum, its resistance to wear and unusually high melting point are putting it into experimental airplane engine pistons. Not only are tremendous amounts of weight saved—and every pound saved in the construction of a plane is worth $40 to the owner of the plane—but it gives better service and enables more power to be taken out of the engine. Both the Army and Navy have purchased sizable quantities for study.

"Be-Al" alloy has about the same weight as pure aluminum and two-thirds that of duralumin, the aluminum alloy now most widely used in airplane construction. Its tensile strength is claimed to be four times that of duralumin and is much greater than that of pure aluminum. Hence its potential usefulness in plane structures.

When added in small amounts to copper, copper's properties are changed amazingly. About two per cent. of the new metal increases its conductivity of electricity by nearly a fifth. Other low-beryllium-content copper alloys are as hard as steel and are used for making machine tools for use in places where steel tools would be dangerous because of sparking.

Beryllium in its pure state is not likely ever to find wide use because it is extremely brittle. But that is apparently its only undesirable physical property, which would make it something of a phenomenon among metals, for almost all others have many more than one serious objection to their characteristics.

It is the third in the trio of light metals which science has brought the world in the last 50 years—aluminum, magnesium and beryllium. In time it is likely to be the most important.

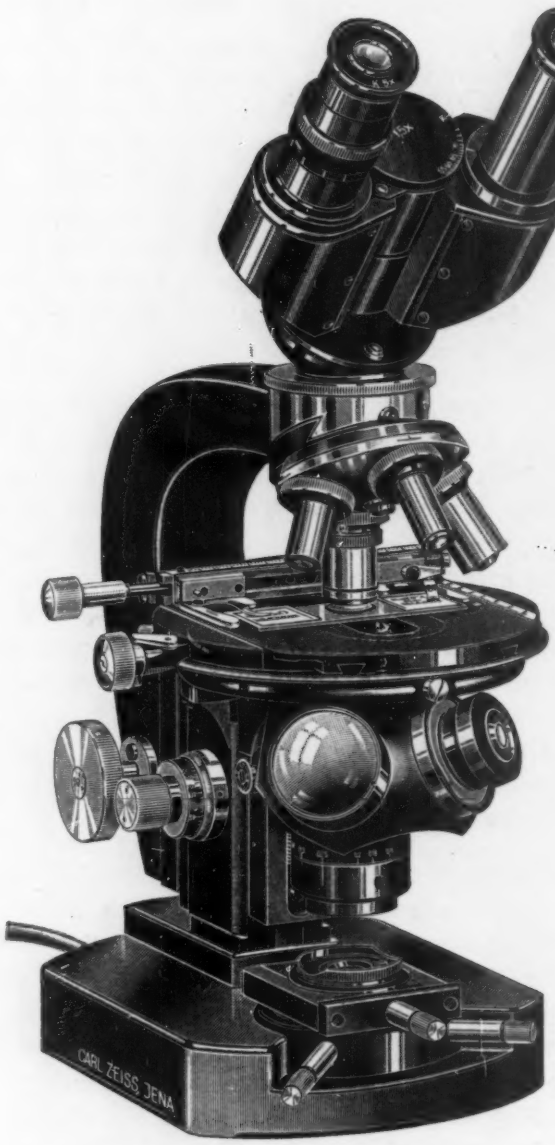
ITEMS

WHILE plans for an American Antarctic expedition are being speeded, the destination of the proposed venture, for which a $340,000 appropriation is asked of Congress, is unannounced. The difficulty of choosing a practical region for the landing and for a scientific laboratory is seen as a main reason. Admiral Byrd, who is being consulted on all matters in regard to the expedition, faced the same problem in guiding his expedition. Major scientific organizations in the United States have been invited to a conference to discuss participation in the Antarctic expedition, by the Interior Department, sponsor of the project. It is expected that these organizations will send men and equipment to study cosmic rays, terrestrial magnetism, and other scientific problems on which an Antarctic laboratory, maintained for three or four years, might make progress.

CHILDREN'S heads grow most rapidly in length between the ages of two and five, in length between two and four. Length increase then drops off sharply until seven, and there are further pulsations of growth until about 13. Then boys' heads take on a new spurt, but girls' heads slow down in growth. These are among the results of measurements taken year after year on the heads of more than 250 children from the time they were two years old until they were sixteen or seventeen, reported in the June issue of *Human Biology* by Dr. Marcus S. Goldstein, of New York University. Girls who reached physiological maturity earliest had heads definitely larger than their late-maturing companions, Dr. Goldstein found.

THE latest reports to the U. S. Public Health Service indicate that the infantile paralysis outbreak in South Carolina continues unabated while the rest of the nation is remarkably free from the disease. The Federal health service has had three officers investigating the outbreak and expects to send experts on infantile paralysis aftercare to South Carolina as soon as possible. During the week ended May 20 there were 28 cases of the ailment in South Carolina, most of them in and around Charleston. In the rest of the nation there were 15 cases scattered throughout nine states. The South Carolina outbreak has been building up since before Christmas, with a sudden increase during the first week in May. Health officials would expect about 19 cases of the disease in the entire country at this time of year. No major outbreak of infantile paralysis has occurred since the summer of 1937. Health officials are unable to predict whether the South Carolina epidemic will remain local or will spread throughout the rest of the country this summer.

GENTLE rains are usually thought of as friends of the soil, in contrast to the heavy, slashing, "gully-washer" type of downpours, yet they also do their share of harm to the land in the Piedmont region of the East and Southeast, declare scientists in the U. S. Soil Conservation Service. The gentle rains soak in, soften the soil, and where gullies have already been cut, the edges and sides crumble and slump off. If this débris were left to lie and become grass-grown, it would not be so bad. But then come the heavy rains, the "gully-washers." They scour the gully bottom clear, leaving these gashes in the earth wider year by year. The cure prescribed: check-dams, planting of grass, bushes and trees, field terraces that follow contour lines and intersect the water's precipitate lines of flow.



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SCIENCE NEWS

Science Service, Washington, D. C.

THE SEARCH FOR CHEMICAL ELEMENTS HEAVIER THAN URANIUM

THE problem of creating super-heavy chemical elements by the bombardment of uranium with neutral atomic particles, the neutrons, apparently is now proved impossible by elaborate and careful experiments performed by the Italian physicist, Dr. Emilio Segrè, working at the radiation laboratory of the University of California. Describing his results in the current issue of *The Physical Review*, Dr. Segrè concludes that "transuranic elements have not yet been observed." Such elements more massive than uranium—heavyweight of all chemical elements—were suggested by the 1934 experiments of Professor Enrico Fermi, of Rome, who is now at Columbia University. Dr. Segrè was one of the group that worked with Professor Fermi in these earlier experiments.

By bombarding uranium with neutrons, Dr. Segrè found that the well-known radioactive isotope of uranium—having a half-life of 23 minutes—was produced. This isotope disintegrated with the emission of an electron, a so-called beta particle. A search for alpha particle emission was unsuccessful.

While he was not able to demonstrate its presence chemically, Dr. Segrè concludes that the beta emission means the isotope breaks down into element 93, which is extremely long-lived. This is in keeping with the present picture of radioactive disintegration, but furnishes only very indirect proof, and makes true Dr. Segrè's conclusion that transuranic elements have not yet been observed.

BLIND LANDING APPARATUS

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ALL landings blind, if need be. Airlines, come fog or high water, virtually as regular as the railroad. That this dream will gradually become reality during the next three years is predicted by government radio experts as blind landing studies begin at Indianapolis.

Minimum ceiling requirements—now 300 feet at the best airports and higher elsewhere—will be lowered a hundred feet at a time as pilots become skilled in the use of landing instruments and as equipment is more widely installed. Paying passengers then will be making regular trips in safety in almost all kinds of weather. A development that has been promised for "next year" for many years now will actually be accomplished.

The engineers foresee early adoption of a standard and practically fool-proof instrument landing system by the airlines and the Civil Aeronautics Authority on the basis of three months of the intensive study to be started at Indianapolis. In Indianapolis to dedicate the authority's first field station, training in earnest of the hundreds of airline pilots in how to come down out of the sky on a radio highway will begin this summer.

Ten airports throughout the United States will soon be equipped with similar blind landing apparatus. The airports are to be chosen so as to encounter the widest possible variety of conditions and afford training facilities to the maximum number of pilots. The new Civil Aeronautics Authority unit at Indianapolis is the only one involving four sets of equipment to allow landings in whatever direction the wind requires. This system, worked out by the radio technical committee for aeronautics and the airlines, and built by the International Telephone Development Corporation, will be adopted as standard with but slight modifications.

Differing somewhat from previous systems, it gives the pilot both sight and sound indications of when he is near the airport and when he is passing over its edge. The glide path is formed by the intersection of two planes of radio waves. A vertical plane is generated by a localizer beam similar to the radio range in regular use. It tells the pilot whether he is to the right or left of his course. A second transmitter sends out its signals from a point 400 feet to the side of the end of the runway, in a plane slanting upwards. The pilot can slide down any part of this plane and reach the ground, but he slides down the particular path marked by the vertical plane of signals. He can come in all the way by radio or guide himself by the boundary lights once he reaches the field, for he is then but 60 to 80 feet up. The weather will have to be phenomenal to make lights invisible at that altitude.

—LEONARD H. ENGEL.

NEW USES FOR COTTON

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COTTON experts, about ready to give up attempts to dissipate by purely economic means a growing cotton surplus, are in the market for new uses of cotton which will remove the downy white stuff from the textile field and which do not compete with already overabundant materials of other kinds, as the only immediate hope for permanent solution of one of America's most serious farm problems.

Hundreds of suggestions for its use have been made, but only two thus far give any hope of absorbing significant amounts of cotton without at the same time striking hard at some other material produced in the United States. The addition of five per cent. of cotton to cheap wood pulp paper and of 15 per cent. to superior grades of paper would at the same time improve the quality of the paper generally used here and cut down on American imports of wood pulp, as well as reduce to a slight extent cutting of America's forests.

A second possibility for consumption of cotton bales by the ten thousand is use of a cheap cotton fabric base for secondary roads. Most of the side roads in this country are still unsurfaced, though miles of concrete highway give a contrary impression. The cotton fabric serves as a cheap reinforcement for the crushed stone dressings and bituminous materials widely used.

Neither of these suggestions is, however, capable of application this year on the scale required to move a substantial portion of the surplus. The difficulties are due partly to the rise of other cotton-producing areas outside the United States and partly to the growth of synthetic

fibers. In 1926 world rayon production represented only 400,000 bales of cotton, but in 1937 the synthetic fiber, which is made usually from wood pulp, represented 4,000,000 bales of cotton—11 per cent. of the 1937 cotton crop throughout the world and 15 per cent. of the 1938 crop.

Rayon will continue its phenomenal growth as long as it is superior to cotton for many purposes. Among the leaders in the manufacture of artificial fibers, incidentally, are precisely those countries which were among the largest customers for American cotton: Japan, Germany and Italy. A new fiber—nylon, a synthetic substitute for silk—may be expected not only to hit silk, but cotton as well.

It would require an incredible amount of clothes to move the mountains of cotton that must be disposed of. About 683,000,000 shirts can be made from 1,000,000 bales of cotton—more than five shirts for every man, woman and child in the United States, according to an expert of the U. S. Department of Agriculture. And the government is currently keeping out of the market 11,391,000 bales—almost the amount of an entire year's crop. Finding methods of putting more cotton into textiles would, therefore, achieve little. Almost every pound of government cotton put into cloth would mean one pound less of currently grown cotton used.

A number of investigators are even suggesting now that the trend of decades of plant breeding—to produce more lint and less seed from a given cotton plant—be reversed and that efforts to produce more seed and less cotton be made instead. Not only would that serve to reduce the amount of cotton produced, but it would also increase the amount of a highly desirable commodity—cottonseed. The hundreds of products made from cottonseed and cottonseed oil have given the seed a larger market than growers have been able to fill.

But just as it required years for cotton to get into its present plight, it may take years before such long-range developments as new uses can take effect on a large scale.—LEONARD H. ENGEL.

SPRING FOREST FIRES

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THE U. S. Forest Service states that forest fires thus far this spring have been more numerous than average, but less destructive. To date, there have been 3,871 fires in national forests, as against a five-year average of 3,497 for the five months January to May. However, the burnover has been at the rate of only 331 acres per million of national forest lands, as compared with the five-year average for the same months of 468 acres per million.

In New England, which was made the most critical of the nation's potential forest fire areas when last fall's hurricane blew down most of its finest trees, large-scale purchase of salvaged timber and energetic organization of the hazard-abatement work have improved the situation considerably. Government purchases amounting to 345¼ million board feet of timber have already been completed. Of this quantity, 63 million board feet have been sawed into lumber. Additional 1,436 million board feet are under agreement to purchase. The agreements have been signed with nearly 10,000 timber owners.

An army of 12,000 men, including CCC and WPA workers, has been in the field all winter and spring, working on fire hazard abatement, and 21 new 50-man camps are now being added. Primary work, such as opening roads and rebuilding telephone lines, has been completed for some time, and efforts are now being concentrated on clean-up work, opening of fire lanes, etc. Thanks to a long and snowy winter and to fairly good rains during the spring, the situation is described as "not serious."

Over the country at large, the fire hazard situation is currently somewhat uneven. East of the Great Plains generally, the classification "low to medium hazard" prevails. In the West and Northwest, from Colorado and the Dakotas through the Great Basin to the Pacific coast, there is greater danger, and in the Southwest the hazard is described as "high."

ITEMS

THE next outburst of sunspots should occur early in 1944 and the next maximum of sunspots should come in the summer of 1948, it is forecast by Professor John Q. Stewart and Forrest C. Eggleston, Princeton University Observatory astronomers. Communicating their forecasts in a letter to the editor of *The Physical Review*, they note that since 1749 A.D. sixteen sunspot cycles have been completed. The seventeenth outburst is not yet complete. The next outburst, number 18, may be expected to commence roughly two thirds of a year after the sunspot number has fallen to one tenth its maximum value. This places the date early in 1944. The new forecast is made by fitting curves to the graphs made in plotting the number of sunspots monthly.

AN infantile paralysis outbreak this summer is very unlikely to occur, health authorities in Washington believe on the basis of reports to the U. S. Public Health Service for the season's critical week. For the week ending June 3, reports of new cases in 27 states already heard from are only 18. If an epidemic were in sight, signs of it would be expected in the most recent reports. Reports from Charleston, where there has been an outbreak, show a decrease. There were only three cases in the city and only seven brought into the city hospital from the surrounding county.

SMALLPOX, in spite of the outbreak in Onondaga County Penitentiary, N. Y., shows signs of a decrease. With 20 cases from New York counted in, the total from 27 states was only 96 for the week ending June 3.

THE new drug, sulfanilamide, has extended its sphere of usefulness to cover otitis media, that extremely painful disease of the middle ear that often is the forerunner of a mastoid operation. Eighty-eight patients with otitis media due to beta hemolytic streptococcus were given sulfanilamide in a recent series of cases and only seven required a mastoid operation, according to the report of Dr. Gilbert E. Fisher, of Baltimore, in the *Journal* of the American Medical Association. In a control group of 95 patients who were given the regular treatment of puncturing the membrane for drainage and irrigation, 66 required a mastoid operation. Moreover, the patients treated with sulfanilamide recovered in one third the time taken by the other group.

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SCIENCE NEWS

Science Service, Washington, D. C.

THE WORK OF MEMORIAL HOSPITAL, NEW YORK

CANCER patients in New York City and in tiny hamlets thousands of miles away will be helped by Memorial Hospital, which opened its new $5,000,000 building on June 14. They will be helped, even though they never cross the threshold of this, the world's first and now largest exclusively cancer hospital, and even though they never have rays from the hospital's new, pocket-edition million-volt x-ray machine trained on the malignant growths that are sapping their lives.

This is true because from this hospital every year there go forth young men trained to detect every variety of cancer, even in the earliest forms, and trained, also, to give the most effective cancer treatment known to science. These young doctors, ready to devote themselves to the fight against cancer and picked for the ability they have already shown during hospital training, are given three and a half years of special training in cancer-fighting under the Rockefeller research fellowships established at Memorial Hospital in 1925. Details of their training were told by Dr. Lloyd F. Craver, chairman of the fellowship committee, at the dedication and opening of the new building. These young men and additional fellows getting the same training at Memorial Hospital under grants from the National Advisory Cancer Council, will not for some time to come constitute a large enough band of cancer-fighters to see all cancer patients throughout the nation. But patients the world over are getting other help from the activities of Memorial Hospital.

New ways of fighting cancer or improvement of old and tried ways and new knowledge about cancer that might lead to its prevention are constantly being developed at the hospital. The new pocket-edition million-volt x-ray machine, described by Dr. William D. Coolidge, of the General Electric Company, whose researches developed it, is an example. Heretofore the benefit of these powerful and penetrating x-rays from million-volt machines had to be limited to hospitals or other institutions that could afford a building 62 feet long, 32 feet wide and 36 feet high to house it. In addition, many tons of lead were needed to protect operators and patients from the cumulative effects of the x-rays.

By improvements described by Dr. Coolidge, a pocket-size edition was developed for Memorial Hospital which can be housed in a grounded metal container four feet in diameter and seven feet long, and complete with its lead protection, this million-volt machine, which is equivalent in radiation to $90,000,000 worth of radium, weighs about 4,000 pounds, including about 1,000 pounds of protecting lead. Many hospitals which could not afford a special building for giant x-ray machines can find room for such pocket-size giants of cancer-killing power.

ANTI-BLEEDING VITAMIN K

(Copyright, 1939, by Science Service)

THE tuberculosis germ, often a cause of severe and fatal bleeding, may shortly give doctors a weapon against bleeding. This surprising possibility seems promised by the discovery that the yellow crystals which give the TB germ its color are a form of vitamin K, called the anti-hemorrhagic vitamin because it prevents or checks tendency to fatal bleeding in obstructive jaundice. The discovery, by Drs. H. J. Almquist and A. A. Klose, of the University of California at Berkeley, is reported in the current issue of the *Journal* of the American Chemical Society.

Although the germs in the body of the tuberculosis patient make this life-saving chemical, which is both coloring matter and vitamin, the patient can not get it from the germs that are making him sick and boring through his blood vessels to cause hemorrhage. Nor would it do him any good if he could, because lack of vitamin K is not the cause of hemorrhage in tuberculosis, and the TB patient does not suffer from lack of blood-clotting substance. Patients with obstructive jaundice, the ailment that turns the skin yellow, do suffer from lack of the blood-clotting substance because in their condition the flow of bile to the intestines is blocked. Without bile, the patient can not absorb vitamin K from his food.

Fortunately, however, the chemical has been extracted from the TB germs and has even been made synthetically by Professor R. J. Anderson, of Yale University, who christened it phthiocol. Some of Professor Anderson's synthetic phthiocol was used in these experiments. "The compound has been definitely shown to be a form of vitamin K. It has physical and chemical properties similar to those known for vitamin K. Fed to chicks with a vitamin K-less diet, the synthetic TB chemical kept the clotting time of the chicks' blood from being dangerously prolonged just as vitamin K itself would.

This discovery essentially completes the vitamin K problem, according to Drs. Almquist and Klose. They believe phthiocol is probably the simplest member of a homologous series of anti-hemorrhagic substances. Their discovery of its identity as vitamin K is considered an amazing outcome of the tedious and even dangerous chemical studies of tuberculosis germs which Professor Anderson has been making for ten years under a grant from the National Tuberculosis Association, made possible by Christmas seal sales.

Professor Anderson believed when he discovered phthiocol that it was a stimulus to growth and might prove valuable some day if scientists could learn how to use it. Firm in this belief, he persuaded Yale University to patent his synthetic phthiocol. It has not yet been made commercially but probably soon will be, and it is expected to be available at a low cost.—JANE STAFFORD.

HURRICANES

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HURRICANES are accepted as inevitable in the Caribbean region, which quails beneath an average of three of these tropical storms in a year, and the hope for the future lies in engineering to provide more adequate protection against wind and flood and in the perfection of weather forecasting methods to provide warning far in advance of the storm.

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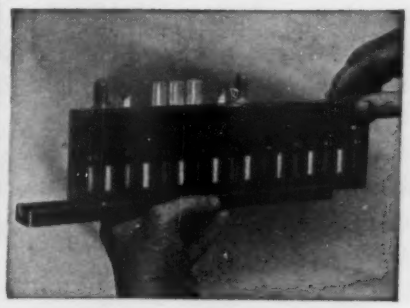

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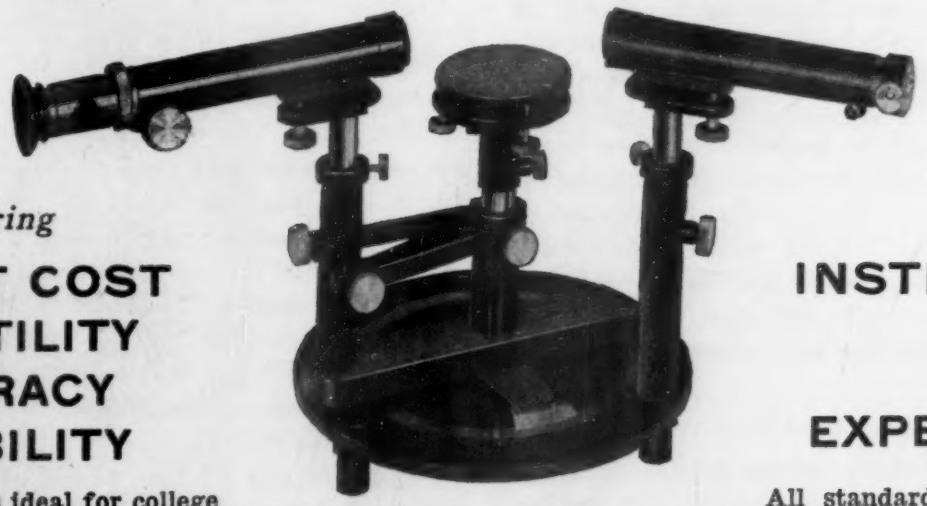

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Various attempts have been made to stop the winds or to divert them from their path, but none of the experiments has been successful, and scientific men generally are skeptical of suggestions that any power now within the hands of mankind is sufficient to cope with the wild force of a hurricane. The terrific strength of the winds may be gauged from scientific calculations which indicate that such a storm will expend in a single day enough energy to run all the power plants of the earth for several years. Small wonder that great ships flee from its path and that cities take refuge behind stout walls.

Atlantic hurricanes all have their birth in the doldrums bordering the equator. That much is known, as is the fact that the high temperatures and humidity and the calm air peculiar to this region during the late summer and early fall are the conditions essential for conjuring up this type of storm. Just what provides the "trigger" action that sets the hurricane in motion has not been entirely explained, but the release of latent heat of condensation is believed to supply the necessary energy. Once started, the hurricane winds gather speed from their own impetus and sometimes reach a velocity as high as 130 miles an hour.

In the Caribbean, the course of the hurricane is usually in a northwesterly direction, the storm turning northward at the Atlantic seaboard and imperiling coastwise shipping if it does not strike land.

The most destructive hurricane of modern times in the western Atlantic region was the Galveston disaster of 1900, in which 6,000 persons lost their lives. Since that time, Miami and Palm Beach have been among the places to feel the whip of the West Indian hurricane.

On September 3, 1930, Santo Domingo was visited by a hurricane in which upwards of 2,000 persons perished and property worth millions of dollars was destroyed. The toll of dead was increased by deaths due to disease which spread because of the disruption of sewer systems and the contamination of water, notwithstanding the fact that airplanes and ships were rushed to the scene with food and medical supplies that prevented the epidemics from running their full course.

Twin to the hurricane of the western hemisphere is the typhoon of the Orient. Like the Caribbean hurricane except in name and direction of its whirl, the typhoon is held in even greater dread, but the vastly larger number who suffer its tyranny do so because the East has not built the strong defense of sea walls and stout buildings that guard the West from the seasonal invasion of tropical storms.

LIQUID COAL

(*Copyright, 1939, by Science Service*)

FORESHADOWING a time when man's immense coal resources, which far outstrip other sources of power available at present, may be put to work in the automobile in place of gasoline, a stock car changed only in one minor respect made a first demonstration at Chicago. Made of finely pulverized coal suspended in an oil "carrier," the new fuel, whose development has attracted the attention of scientific men and engineers during the last twenty years, has enabled the car, an eight-cylinder 1939 sedan, to accelerate up to 35 miles an hour within a block.

Applied to a standard automobile by Dr. Francis W. Godwin, director of the coal research division of the research foundation of the Armour Institute of Technology, the fuel is more economical than gasoline, although the cost per gallon is about the same, because it contains far more energy. Neither the carburetor nor the ignition system of the car was changed in any way. One fine-screened filter was removed from the fuel system to accommodate the colloidal fuel.

Because coal itself is essentially inconvenient to handle and bulky, scientific men have been trying to devise a workable "liquid coal" such as this for many years. Thus far, however, it was stated in Washington, all such fuels have been impossible to use economically in an internal combustion engine because of the ash which coal leaves and which causes great wear and tear on the moving parts of the engine. It is not known whether the new development has overcome this difficulty.

Dr. Godwin stated that three different types of liquid coal have been successfully used in the tests on the stock model automobile. The first was a suspension of a specially prepared coal ground to 300 mesh in a mixture of gasoline, fuel oil and lubricating oil. The second was a similar suspension of the coal in a Diesel oil. The third test was made with a very light oil. In each case, the liquid coal was chemically stabilized to hold the coal in suspension. The demonstration car was started on gasoline. The liquid coal was fed to the motor from an auxiliary tank after the motor had reached "driving heat."

The fuel can be marketed for about ten cents a gallon. Dr. Godman foresees its most immediate automotive usefulness in the Diesel field.

A NEW TYPE OF GLASS

(*Copyright, 1939, by Science Service*)

A REMARKABLE new type of glass which can be heated cherry red and then plunged into ice water without danger of breaking—the latest advance in the science of glass making—is announced by the Corning Glass Works at Corning, N. Y. It will be two years before vessels of this new glass can be offered to the public. In the meantime a small pilot plant will be in operation to test the commercial manufacturing problems.

The secret of the new glass is its extremely low coefficient of expansion with temperature change. It virtually rivals expensive quartz in this vital property. The synthetic "quartz" was developed by H. P. Hood and Dr. Martin E. Nordberg under direction of W. C. Taylor, chief chemist of the Corning Glass Works.

While products of the new glass show virtually no change of dimensions when heated or cooled, because of its low expansion, it is quite a different story in the manufacture of the glass itself. Articles made of it, for example, must be made one third larger than the desired final volume. Thus to get a nine-inch dish you first make one ten and a half inches in diameter. It ends up as a nine-inch dish as follows: First, the dish is molded in the usual way, but with the special glass formula to start with. Then by a series of steps, involving a final stage of leaching with dilute nitric acid, part of the structure

of the glass is removed, leaving behind a "skeleton." By further heat treatment this skeleton shrinks down to a volume which is 35 per cent. smaller than the original size. The acid treatment removes 36 per cent. of the body of the glass and leaves 64 per cent. behind. At this stage the glass dish feels rough to the touch, but does not feel porous. Actually at this stage it is filled with sub-microscopic air spaces. By final heat treatment the glass body shrinks just a bit more to a transparent, homogeneous state in which it is practically 96 per cent. pure silica. In this completed state it can be heated red hot and then dipped in ice water without cracking.

For all practical purposes the new low-expansion glass is equal to fused quartz and fused silica in its resistance to thermal shock. Fused quartz is costly because it is extremely difficult to fabricate, requiring a very high temperature for melting. Further difficulties arise from lack of suitable refractory materials in which to melt it and from the fact that the melting and vaporization points are close together. The new glass surmounts these difficulties. To give an idea of contrast between the old and the new glass, the following comparative figures for expansions are given: ordinary window glass 80, Pyrex baking glassware 32, and the new glass only 8. The goal is zero expansion. The new glass, it can be seen, has dropped nine tenths of the way to zero.

ITEMS

ORGANIZED medicine, already on record by American Medical Association resolution as opposing the Wagner Health Bill, expressed itself through its witnesses at Senate committee hearings as suspicious of the proposed Federal aid to states in providing more hospitals, giving compensation to those temporarily disabled by illness, and giving grants through states for medical care of those who can not pay for it themselves.

BUBONIC plague, like other forms of death in these days, has apparently taken to air travel. Not on the man-made wings of airplanes, but on the wings of hawks, owls, crows and other predatory and scavenger birds is reported by the U. S. Public Health Service. The suggestion comes from William L. Jellison, assistant parasitologist at the Rocky Mountain Laboratory of the Service. Thirty years ago, Dr. W. C. Rucker made a similar suggestion, but limited it to one species of burrowing owl that shares habitations with the ground squirrels and other rodents that carry fleas which are in turn the ultimate carriers of the plague germs. Mr. Jellison, however, greatly extends the list of suspected birds, to include two species of hawks, two of falcon, three of owl and one species each of eagle, magpie and crow. All these birds prey abundantly on the plague-carrying rodents. The scavengers, like crows, devour their catches on the spot, but predators, like hawks and owls, carry the carcasses to their nests, with the possibility of distributing the fleas either on the way or after they arrive. In several cases, these flesh-eating birds were observed in attacks on rodents dead or dying of the plague.

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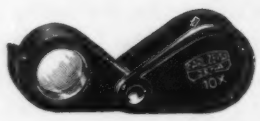

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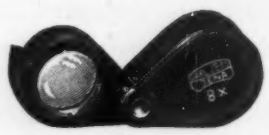

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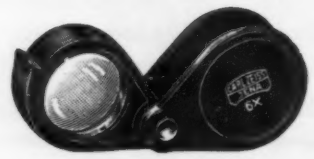

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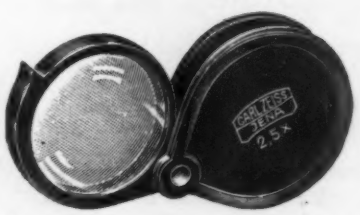

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SCIENCE NEWS

Science Service, Washington, D. C.

THE NATIONAL HEALTH PROGRAM

A DEFENCE of the National Health Program and specific answers to various criticisms of it were issued by Surgeon General Thomas Parran, U. S. Public Health Service, in an address, read for him, to the National Conference of Social Work meeting in Buffalo on June 21.

"The National Health Program," in Dr. Parran's words, "represents the most comprehensive approach ever made towards solving the diverse and serious problems retarding our nation's health."

Its objectives, he stated, are to reduce the volume of sickness and ill health by extending preventive services to all areas and people, to provide for construction and maintenance of hospitals where needed and for support of existing hospitals, to reduce disability and lengthen life by more prompt and adequate medical care of the sick, to extend indirect health protection to the worker and his family by compensation for wages lost through nonindustrial sickness and accident, and to promote greater federal effort on research in prevention and cure of diseases not now controllable.

"It is not proposed that the health and medical services of the country be federalized," Dr. Parran explained. He pointed out the need to-day for "group cooperative action in the rendering of medical service no less than in payment for it" and warned against standardization and creation of vested interests that would resist future change. "The national health program does not recommend a national system of compulsory health insurance nor does it require nor coerce the states to do so," he said in answer to the charge that the national health program would lead to such a system.

To criticism of the estimated expense of the program, he pointed out that this amounts to a "*per capita* daily expenditure of one and seven eighths cents on the average for each of us."

"Much of the opposition on the part of many people, doctors, and patients alike, to any great extension of public medical service arises," he said, "because the public medical service now provided in so many communities is of such inferior quality. A similar distrust arises from the untrained health officer who still is cherished in so many of our communities. . . . "The greatest contribution that social workers can make to future sound progress in national health is by doing a better job in the provision of medical service for which you are now legally responsible."

Dr. Parran answered the charge that our present low death rate shows that we do not need a national health program by saying: "The death rates alone you must remember are not a measure of national fitness. They do not reveal the estimated 250,000 people who are suffering from silicosis, nor the 90,000 to 100,000 cases of pellagra which occurred last year in the South, nor the recent epidemic of scurvy in Maine."

NEW PICTURE OF ATOMS

(*Copyright 1939 by Science Service*)

SCIENTISTS have a new electrical picture of the unseeable atom—an egg-shaped globe of electrical charge.

The new atom portrait was painted verbally at the meeting of the American Physical Society at Princeton on June 24 by a four-man research team from Columbia University, Professor I. I. Rabi and Drs. L. M. B. Kellogg, N. F. Ramsay and J. R. Zacharias.

Telling their scientific colleagues that they had "confirmed the existence of the deutron quadrupole moment" the Columbia investigators described how they made the discovery of egg-shaped electrical pattern for deuterium atoms. Deuterons are the electrically charged nuclei of this rare kind of heavyweight hydrogen.

The new results of egg-shaped electrical distribution are helping the mathematical physicists in their important calculations of the inter-nuclear forces; forces which determine how all material matter is put together.

Running the ions through a special six-foot-long vacuum tank, the four different magnetic fields were used. The first field has a distorted kind of magnetism that spreads the ions out and deflects them into curved paths. As they come to a central collimating slit only those with a given orientation of their magnetic axis can pass through. Having passed the slit the lucky ones next encounter a homogeneous magnetic field that shifts their orientation by known amounts. And superimposed at this point is still another magnetic field created by a high-frequency radio transmitter. When the radio field is turned exactly to the frequency of the ions resonance occurs, and a fourth and final lopsided magnetic field is then able to focus the ions on the receiver.

What the experiment really detects is the resonance vibrations of the ions in terms of exactly known radio frequencies. Plotting out the measurements curves are obtained on which resonance points resemble spectral lines on a photographic plate. In fact, the operations of Professor Rabi's apparatus are in many ways comparable to those of a spectrograph except that he works with magnetic fields instead of rays of light. Where a spectrograph picks up light rays and forms characteristically-placed spectral lines, the Rabi equipment detects characteristic resonance points formed by the magnetic properties of the atoms and molecules. The placement of these points is likewise unique for each element.—ROBERT D. POTTER.

THE CHICAGO SYMPOSIUM ON COSMIC RAYS

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COSMIC radiation, at sea level has only a hundred-millionth the energy of an x-ray beam. This determination has been made possible by a new "yardstick" for determining the absolute value of cosmic ray intensity described at the symposium on cosmic rays at the Univer-

sity of Chicago by Dr. J. Clay, of the University of Amsterdam.

Dr. Clay is one of a score of notable foreign scientific men attending the cosmic ray symposium, together with nearly a hundred American scientists, all experts in studying the behavior of these visiting radiations from outer space.

The "yardstick," devised by Dr. Clay, is the ionization in air produced by cosmic radiation. At sea level after suffering much stoppage on their way to the earth, cosmic rays create less electric current by ionization than is normally present in the human body as determined by "brain wave" experiments and other tests on the body's electricity. The cosmic ray ionization current is, in fact, one of the smallest electric currents with which scientists have to deal. For years the discovery of cosmic rays escaped detection.

The veteran scientist who first found cosmic rays was Professor Victor F. Hess, who sent up free balloons between 1912 and 1914 carrying instruments proving the presence of these radiations. Professor Hess, years later in 1936, received the Nobel Prize for this epochal discovery. A German Catholic, Professor Hess is now in the United States teaching at Fordham University because he is not in agreement with current Nazi views of science.

While—as the discoverer of cosmic rays—Professor Hess is perhaps the honored guest at the symposium at Chicago, he is only one of five Nobel Prize laureates in attendance. From the California Institute of Technology have come Professor Robert A. Millikan, pioneer American investigator of cosmic rays, and his colleague, Dr. Carl D. Anderson. Professor Arthur H. Compton, of the university, is director of the symposium, and present too is the famed theoretical physicist from the University of Leipzig, Dr. Werner Karl Heisenberg.

Besides Professor Clay's "yardstick" for cosmic rays the first day's session of the symposium was the announcement of the finding of Dr. W. P. Jesse, research associate of Professor Compton at Chicago, that the intensity of cosmic radiation increased 10 per cent. last winter over what it is this spring and summer. While many more observations will be needed, Dr. Jesse's results appear to show a seasonal effect of cosmic rays.

Much discussion too centered around the findings of Dr. S. A. Korff, former Russian baron who is now a member of the Bartol Research Foundation of the Franklin Institute, that the atomic particles known as neutrons are much more plentiful at high altitudes than at sea level. Their increase with height, moreover, is ten times as rapid as is the gradual increase in cosmic radiation itself. A splitting of nitrogen atoms into helium atoms was suggested by Dr. Korff as the cause of this discovery. Only within the last six months has it been possible to measure neutrons high overhead in the stratosphere. A new kind of neutron meter invented by Dr. Korff and Dr. William Danforth, of the Bartol Foundation, has made the work possible.

PREVALENCE OF TUBERCULOSIS

THE number of middle-aged and elderly patients in tuberculosis sanatoriums has increased in recent years and a greater number of tuberculosis deaths are occurring in the higher age groups, Dr. Richard H. Overholt told members of the American Sanatorium Association at their meeting in Boston on June 26.

Rehabilitation of these patients presents a real problem, Dr. Overholt declared. It is often difficult to isolate the older patients. They get discouraged with prolonged life in the sanatorium and frequently leave the hospital against advice and while still in the infectious stage. As a result, their children and grandchildren are again exposed to tuberculosis.

Differing with some medical authorities, Dr. Overholt believes permanent collapse of the affected lung by surgical operation will benefit many of these patients. The procedure "has been tolerated extremely well," he said, by patients in the fifties, sixties and seventies upon whom he operated.

The danger to other patients and the staffs of general hospitals from unrecognized cases of tuberculosis was pointed out by Drs. Edward X. Mikol and Robert E. Plunkett, of Albany, N. Y.

More than 40,000 patients with unrecognized pulmonary tuberculosis were sent to hospitals for other conditions during a single year, 1937, they estimate on the basis of a New York State Department of Health survey.

"From these patients there is danger of transmission of tuberculous infection to other patients and particularly to the nursing and medical staffs," the Albany doctors declared. Numerous investigations have shown that tuberculous infection and disease are more prevalent among nurses than among women in the same age groups in other occupations.

AMATEUR ASTRONOMERS FIND NEW COMET

(Copyright 1939 by Science Service)

A GROUP of Washington amateur astronomers has discovered a new ninth magnitude comet, the U. S. Naval Observatory believes. Looking through a small homemade six-inch reflecting telescope, the amateur observers found a moving object while watching the giant whirlpool nebula near Canes Venatici, constellation high in the northern sky near the big dipper.

Found on June 21, at about 11 P.M., the comet has the approximate position of right ascension 13 hours and declination plus 40 degrees. An accurate check on position will not be possible until the larger, more exact instruments of the U. S. Naval Observatory have been turned upon the comet. In the meantime, the approximate position has been wired to Harvard College Observatory, American clearing house for astronomical information, so that other observers may find it too.

The discovery was made accidentally, for the group from the National Capital Amateur Astronomical Association was studying the whirlpool nebula and was amazed to find one of the supposed stars in the field of view moving rapidly. Best rough estimate of motion is about three minutes of arc per hour, or roughly one tenth of the sun's diameter.

While the comet is too faint to be seen with the unaided eye, it may be approaching the region of the sun and earth and hence come into naked eye view. At the moment

a low-powered telescope will find it about midway on the line between the bright star Arcturus and the stars forming the "bottom" of the bowl in the big dipper.

Another way is to form an imaginary line through the Pole Star and the second star of the handle on the dipper and project the line down toward the horizon. Where these two lines meet is very near the new comet's position.—ROBERT D. POTTER.

HOSPITALS FOR TUBERCULOSIS IN THE SOUTH

THE need for better tuberculosis hospitals and sanatoria is greatest in the South, according to Dr. Joseph W. Mountin, of the U. S. Public Health Service, who spoke at the Boston meeting of the National Tuberculosis Association. He said that "Though there is undoubtedly need for improvement in each area, the southern states mark the line for first attack." "Need for hospital facilities, it is agreed, is probably most adequately expressed not by total population but by prevalence of tuberculosis as indicated by death rates for the disease."

He and his associates in the Federal Health Service, Elliott H. Pennell and Kay Pearson, reported that the South, with its high mortality rate, provides only two thirds of a bed for each tuberculosis death occurring there. At the same time western states with only a slightly greater death rate afford almost two beds per death. The northeastern and central regions, lowest in proportionate number of deaths, have available 1.7 and 1.5 beds, respectively.

Operating costs also ran lowest in the South of any section. This may be due wholly to economic circumstances, but it is more likely that completeness of equipment and quality of service exert considerable influence.

Another angle of the tuberculosis hospital situation was brought out by Dr. Ernest B. Emerson, of Rutland, Mass. He stated that "More progress has been made in the treatment of this disease during the past 40 years than in all the time that has gone before. Recognizing that there are other factors in addition to sanatorium treatment, the death rate is approximately a fifth of what it was forty years ago. Should the present trend continue, one can foresee that our hospitals and organizations may ultimately serve another purpose."

ITEMS

BROOKS' periodic comet—first found in 1889 and which has returned every seven years since that time—is now back within the range of telescopes of American astronomers, according to Dr. Harlow Shapley, of Harvard College Observatory, the American center for the distribution of astronomical information. Of the 17th magnitude, Brooks' comet is much too faint to be seen with the unaided eye. It was found on photographs taken at Lick Observatory, Mt. Hamilton, Calif., by Dr. H. M. Jeffers and Miss Adams Wright. The date of the discovery was June 17, at which time it was a diffuse object with nothing reported about its tail.

HAVING already shown that atomic energy can be released by smashing uranium and thorium atoms with neutrons, there is another element that theoretically is worth attacking. Protactinium, heavy radioactive metallic element, has a good possibility of being split by bombardment and yielding a large share of its atomic energy, according to Dr. John A. Wheeler, of Princeton University, who spoke before the American Physical Society at its recent Princeton meeting.

SULFANILAMIDE and sulfapyridine, already hailed far and wide as successful remedies for pneumonia, streptococcus infections, gonorrhea and other diseases, may prove equally effective as a remedy for typhoid fever. Good results with the chemical remedies in seven severe cases of typhoid fever are reported by Drs. E. H. R. Harries, Robert Swyer and Noel Thompson, of the North Eastern Hospital in London. The most striking result was obtained in the case of a man who had "walking" typhoid and for whom any experienced doctor would have predicted a long and perilous illness. Within ten days after entering the hospital he was in the recovery or convalescent stage. This patient was given both sulfapyridine and a serum, and the doctors suggest that this combination is probably the thing to use for treating other cases.

CONSIDER all ticks dangerous, advises the U. S. Public Health Service, even though only one in 300 of the eight-legged pests is capable of transmitting spotted fever, in the most heavily infected areas. If you live where ticks abound, or if your dog brings them to the house after cruising in the brush, better examine yourself all over at least once a day. If you find a tick has taken hold, remove him with a pair of tweezers or a small piece of cotton or paper, being careful not to crush it. Tick "juice" can be very dangerous. Drop the tick in kerosene or gasoline, to kill it. Swab the bitten spot with iodine, and dip your fingers and the forceps in alcohol or wash them thoroughly, the Public Health Service advises. It is highly advisable also to "de-tick" your dog at frequent intervals, with the same precautions.

THE new drug sulfanilamide appears to have value in treating smallpox. Four cases in which it largely prevented the eruption from the disease are reported in the *Journal* of the American Medical Association by Dr. Walter O. McCammon, of Springfield, Ky. Seven cases of smallpox recently came under the observation of Dr. McCammon. He used sulfanilamide in treating four, and there was only a slight eruption, which soon disappeared. The patients were back at work a week sooner than were the other three cases which were treated symptomatically and in which the typical eruption of smallpox developed. In an editorial the medical journal points out that no conclusions as to the value of sulfanilamide in preventing deaths from smallpox can be drawn from such a small number of cases. Although smallpox is increasing (there were 14,355 cases reported last year) the disease is now mild.

FOR transmitting television signals short distances, telephone engineers can now use ordinary telephone cables instead of the special coaxial conductors best suited for the relaying of television. Tests show that the ordinary cable pairs can be used when necessary in getting the signals from a spot television location to near-by coaxial cable or transmitter, although the loss of energy over the ordinary telephone channels is a million times greater than over the special television cables.

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